THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 35. Thursday, May 12, 1927. No. 569.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telephone: Gerrard 3951 (4 lines).
Telegraphic Address: "Zacatecas, Rand, London."

Contents.

	PAGE
The Specification of Pig and Cast Iron	389
Correspondence	390
The Iron and Steel Institute—Annual Meeting in London	391
United States Pig-Iron Output, 1926	396
Carbon and Silicon in Cast Iron	397
The Continental Steel Trust	399
Personal	399
Co-operative Industrial Research	400
The Foundry Accident Problem	401
Institute of British Foundrymen	390, 403
Rubber Equipment in Foundries	403
Thicknessing Moulds to Produce Cylinder Castings	404
Trade Talk	406
Contracts Open	406
Company Reports	406
New Companies	406
Iron and Steel Markets	408

Forthcoming Events.

MAY 18.

Royal Society of Arts:—Ordinary meeting in London. "Industrial Welfare in Great Britain and the United States." Paper by Robert R. Hyde. Sir Robert A. Hadfield, Bt., D.Sc., F.R.S., will preside.

MAY 19.

Institution of Mining and Metallurgy Council Club:—Ordinary meeting at Engineers' Club, London, W.1.

MAY 19 to 21.

Institute of Transport:—Congress at Birmingham.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1926-27: Vincent C. Faulkner, "Thalassa," Carlton Avenue, Kenton, Middlesex.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office, 49, Wellington Street, London, W.C.2.
Birmingham: F. K. Neath, 16, Sarehole Road, Hall Green, Birmingham.
Sheffield: R. Village, "Bircholme," Dronfield, near Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: H. Stead, 1st/36, Cheetham Hill Road, Stalybridge, Cheshire.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
Newcastle-on-Tyne: Colin Gresty, 101, Queen's Road, Monkseaton, Northumberland.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
West Riding of Yorkshire Branch: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.
Middlesbrough: N. D. Ridsdale, 3, Wilson Street, Middlesbrough.

Welsh Engineers' and Founders' Association
Secretary: P. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Specification of Pig and Cast Iron.

Specifications for a number of high-quality irons have been drawn up by makers and users conjointly, and issued by the British Engineering Standards Association, and there is a tendency for this process to continue. Moreover, the preparation of general specifications of the same kind is proceeding. How will this affect the attitude of the founder towards pig-iron?

The natural reply might at first sight appear to be that if the founder is compelled to produce castings to specification he should be enabled to use pig-irons produced in the same way. Further thought, however, will show that this does not necessarily follow. The founder requires of pig-iron that it be, firstly as cheap as possible, and secondly as uniform as possible from consignment to consignment. It is therefore to his interest that blast-furnace owners should be able to work on long furnace runs without being embarrassed by small demands for special qualities. This applies whether the furnace be large or small, and is irrespective of the type of iron produced, i.e., high or low phosphorus, hot or cold blast, etc.

This country is fortunate in having furnaces which can meet any reasonable requirement with respect to quality. We believe, therefore, that the best plan for the founder meeting specifications for cast iron is to purchase different pig-irons, not to specification, but to makers' analysis or grade number, and to secure the desired results by scientific mixing. Thus the founder would not ask the furnace for a particular analysis, but in choosing suppliers he would take a number of irons available and would from each require an accurate analysis for mixing purposes. Such a procedure will often necessitate setting up a laboratory in the foundry with the means for scientific control, but no founder to-day expects to produce quality irons without some such provision.

There is little doubt that many foundries obtain the equivalent to purchasing to specification by adhering to well-known brands of coke or pig-iron, and there is, of course, an altogether admirable and natural desire to continue using well-known and tried materials. Some foundries, it is feared, by this means postpone the necessity for employing a chemist by throwing the onus of analysis, so to speak, on to the producer, and relying on his integrity to maintain the same quality. Such a tendency we regard as unfortunate, because it not only places these foundries in a position of subservience to the producer—how often do we not meet the man who cannot make castings without So-and-so's coke?—but it is seldom justifiable on economic grounds. Purchase in a free market often yields savings considerable enough to pay for all the scientific control needed, and sometimes this control makes all the difference as to whether the foundry can keep open or not—a point which was brought home during the coal dispute.

We do not, of course, suggest that any pig-iron can be bought academically on analysis, but the founder, if satisfied on other points, should certainly ask for the analysis of the metal he is buying. No blast-furnace owner could, we think, have any objection to supplying it, especially if he were freed from the purchasing specifications for pig-iron used in some quarters. We suggest, therefore, that specifications for pig-iron are not an inevitable corollary of specifications for cast iron.

Institute of British Foundrymen.

WEST YORKSHIRE BRANCH.

Annual Meeting.

The sixth annual meeting of this Branch was held on April 30 at the Bradford Technical College, under the presidency of Mr. W. Parker, of Halifax. The meeting was preceded by a tea, in the Refectory of the College, at which the members were the guests of the President. Following this, hearty thanks to the President were accorded on the proposition of Mr. W. G. Thornton (Bradford), seconded by Mr. H. Sayers (Leeds).

At the business meeting which followed the Hon. Secretary (Mr. S. W. Wise, of Bradford) submitted his annual report, in which he said the session could be regarded as "relatively successful." The financial position of the Branch was quite satisfactory, leaving a credit balance on the year's working. There had been a steady influx of new members during the year, and in spite of the fact that four members had resigned and 18 had ceased membership according to rule, the Branch had to-day a total membership of 80. Mr. Wise gave an analysis of the membership in the various districts covered by the Branch, indicating the areas in which membership was weak and needed recruiting efforts. During the session the Branch had maintained an average attendance of 40. Although this was only 50 per cent. of the membership strength it was a very good percentage in comparison with trade or professional societies generally. After all, suggested the Secretary, numerical strength without real "live" interest was not what was desired. He felt sure the members generally would realise that the membership possibilities of an important district like West Yorkshire were by no means exhausted. It was hoped to arrange a series of interesting works' visits during the coming summer, details of which would be issued to the members shortly.

Mr. J. Robinson voiced the thanks of the meeting to Mr. Wise, paying tribute to his enthusiastic work. As a past-Secretary himself he knew something of the work involved, and congratulated Mr. Wise on the work he had accomplished.

The following officers were elected for 1927-28:—As *President*, Mr. W. Parker (Halifax); as *Vice-Presidents*, Mr. G. W. Thornton and Mr. H. Sayers; as *Members of the Council*, Mr. W. Hird, Mr. J. W. Blair (York), and Mr. A. S. Worcester (Huddersfield); *Hon. Secretary and Treasurer*, Mr. S. W. Wise, who was re-elected for a third year. Mr. Worcester, a new member of the Branch Council, formerly served in a similar capacity in the East Midlands.

Mr. Wise, responding to the vote of thanks, said the work had been one of the happiest tasks he had ever undertaken. He had come into the Branch four years ago, and the close contact with the members which the secretarial work had brought to him had been a very happy experience. (Hear, hear.) He invited suggestions for increasing the membership strength in weak districts. They had to cover a very widespread district, and had not the advantage—as had districts like Newcastle area—of having the foundries of the area fairly close together.

On the motion of Mr. Worcester, seconded by Mr. Poole, it was resolved that a sum from the funds of the Branch be expended during the year in the foundation of a library of books on subjects interesting to members.

The meeting instructed the Council to endeavour to arrange for two inter-Branch meetings next winter—one in West Yorkshire and one away.

SHEFFIELD BRANCH.

A meeting of this Branch was held at the Albany Hotel Sheffield, on April 22. At the general meeting of members which preceded the lecture the following officers were elected:—*President*, Mr. Ambrose Firth; *Vice-Presidents*, Mr. J. T. Goodwin and Mr. George Oxley; *Branch Council*, Messrs. A. L. Steggles, H. Bradley, G. E. Roberts, C. Webster, J. F. Kayser, F. A. Melmoth, R. Village, C. W. Hampton, and the Hon. John North; *Hon. Secretary*, Mr. T. R. Walker, 42, Firth Park Crescent, Sheffield; *Hon. Treasurer*, Mr. W. A. Macdonald; *Auditors*, Mr. P. Green and Commander L. Jackson; *Delegates to the General Council*, Messrs. J. R. Hyde, J. F. Kayser, and G. Oxley.

LANCASHIRE BRANCH: Junior Section.

The third annual examination for the "John Wilkinson" Medal presented by M. J. Thewlis Johnson, of the firm of Messrs. Richard Johnson & Nephew, Manchester, was held on May 7 at the Manchester College of Technology. The competition is open to members of the Junior Section of the Lancashire Branch of the I.B.F., and between thirty and forty candidates took part. Following the lines adopted in previous years the examination paper, which was prepared by a committee of members of the Senior Section of the Branch, was divided into two parts. Part A was sub-divided into five sections, iron founding, brass founding, pattern making, core making and metallurgy. In each section a number of questions were asked, three answers were given to the questions, and the candidate was required to indicate which of the three he believed to be the correct answer. This method has been adopted in order that the candidate who possesses practical knowledge but is unable to express himself on paper may not be handicapped in comparison with others who can write more fluently, but perhaps with less knowledge. It has been pointed out that a candidate may in his uncertainty about a particular question resort to guessing, and if by chance he selects the correct answer it does not show that he has real knowledge of the subject. However, experience has proved that there is no risk of success in the competition being due to such a haphazard method. No guesser can achieve reasonably high marks.

The second part of the paper, B, consisted of a number of questions and the candidate was required to reply in writing in the conventional way, to two of these, selected by himself.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Unannealed Centrifugal Castings.

To the Editor of The Foundry Trade Journal.

Sir,—We have read the Paper describing the "Holley Permanent Mould Process," by Professor J. W. Hinchley, which appears in your issue dated May 5.

On page 381 a reference is made to the centrifugal casting process, in which it is stated that "The permanent iron mould was used, but the metal must be annealed after casting, or the product was useless." We wish to point out that this statement is quite inaccurate and such an expression on the part of a writer of Professor Hinchley's standing shows that he has given but superficial thought to the subject. Hundreds of thousands of castings have been made by the centrifugal casting process and sold in this country, and in all cases metal moulds have been used without any dressing of any sort, and the castings produced are grey iron, easily machined, and are subjected to no annealing treatment whatsoever.

In view of the authority which might be attached to this statement by Professor Hinchley, we should be glad if he would take steps to withdraw it.—We are, Yours, etc.,

for Newton, Chambers & Company, Limited,
Centrifugal Castings Dept.,
J. E. Hurst.

Thorncliffe Ironworks,
near Sheffield.

The names of the undermentioned companies have been struck off the Register of Joint Stock Companies, and such companies are dissolved:—Asbestos and Engineers' Stores Company, Limited. Automatic Gas Producers, Limited. B. Barnett (Electrical Engineers), Limited.

The Iron and Steel Institute.

ANNUAL MEETING IN LONDON.

The annual general meeting of the Iron and Steel Institute was opened at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday of last week. At the outset the retiring President (Sir W. Peter Rylands) took the chair.

Report of Council.

The Council of the Institute, in their report for the year 1926, state that during the year 124 new members and 14 associates were elected, and 11 associates were transferred to membership. Fifty-three members and two associates resigned their membership during the year, and the names of 41 members were removed from the register owing to the non-payment of their subscriptions. The total membership of the Institute on the register on December 31, 1926, was accordingly as follows: Patron, 1; honorary members, 5; life members, 79; ordinary members, 1,909; associates, 21; total, 2,015. In the past year two Honorary Members have been added to the list, namely, Dr. Emil Schrödter, D.Ing., late Secretary of the German Society of Ironmasters, Düsseldorf, and Mr. Jonas C. Kjellberg, President of the Swedish Ironmasters' Association at Stockholm. Dr. Schrödter, who was originally elected an Honorary Member in 1911, was re-elected in May, and Mr. Kjellberg was elected on the occasion of the autumn meeting at Stockholm.

The deaths of 30 members occurred during the year, and the Council record their sense of the great loss to the Institute incurred through the deaths of Mr. Charles Markham, a member of the Council, and of Colonel Sir John Roper Wright, Bt. Mr. Walter Dixon and Mr. J. Rossiter Hoyle were also well known as constant attendants at the meetings of the Institute.

Finance.—The income for the year, apart from that of the Carnegie Scholarship Fund and of the Special Purposes Fund, was £8,136, and the expenditure was £8,160, as against £7,952 and £8,084 respectively in 1925. On the income side there is a diminution in the receipts from annual subscriptions, which may be taken as an indication of the effect on the Institute of the unsettled condition of the iron and steel industry during the past year, due to the prolonged coal strike.

Andrew Carnegie Research Scholarships.—On the recommendation of the Carnegie Research Committee, grants were made by the Council during the year to the following candidates:—

F. H. ARNFELT (Stockholm), £100 to carry out a research on the structure of iron-aluminium alloys, mainly by means of X-ray analysis.

V. N. KRIVOBOK (Pittsburgh, U.S.A.), £100, to carry out a photo-microscopic study of recrystallisation of metals after cold-working.

A. G. LOBLEY and C. L. BETTS (Manchester), £100, jointly to carry out an investigation on the viscosity of iron and steel at high temperatures.

A. R. PAGE (Birmingham), £100, to study the hardening and tempering of high-speed steels.

T. VER (Budapest), £100, to study the effect of alternating stresses on the structure and mechanical properties of metals.

It was also agreed that, the Committee being satisfied as to the progress of the research work undertaken by the two following investigators, to whom grants have previously been awarded, further grants be made to them of the amounts specified:—

L. B. PFEIL (Swansea), £100, to continue his investigations on the growth and properties of single iron crystals.

MR. F. W. HARBORD received his scientific education at the Royal School of Mines, where he graduated in 1879 to 1882. After leaving there he was for a short time with the late Dr. J. E. Stead at Middlesbrough, and was then appointed as metallurgical chemist at the works of Alfred Hickman, Limited, Staffordshire Steel and Ingot Iron Works, Bilston. He next became manager of the steel works of Messrs. Hatton, Sons & Company, Bilston. In 1892 he was appointed Metallurgical Chemist to the Government of India at the Royal Indian Engineering College, Cooper's Hill, and in 1904 Metallurgist to a Commission sent over by the Canadian Government to investigate and report on the position of electric smelting in Europe. In 1909 he was appointed by the Transvaal Government to visit that country and report on the commercial possibilities of iron and steel manufacture in the Colony. In 1916 he was awarded the Bessemer Gold Medal in recognition of his work in connection with the metallurgy of iron and steel. During the war he acted as Consulting Metallurgist to the Ministry of Munitions. In addition to his well-known book, "The Metallurgy of Steel," now in its seventh edition, he is the author of various Papers read before the Iron and Steel Institute and other societies. He is now senior partner in the firm of Riley, Harbord & Law, Consulting Metallurgists, at 16, Victoria Street, Westminster. For his war services he was made a Companion of the British Empire, and the French Government also conferred upon him the honour of Chevalier of the Legion of Honour. He is past President of the Institution of Mining and Metallurgy, Associate of the Royal School of Mines, Fellow of the Institute of Chemistry, and Fellow of the Chemical Society.

MR. F. W. HARBORD, C.B.E.,
President of the Iron and Steel Institute.

J. H. PARTRIDGE (Birmingham), £50, to continue his investigations on the electric and magnetic properties of cast iron.

Changes on the Council.—Mr. George Hatton, C.B.E., Mr. Harry Brearley, and Mr. Alfred Hutchinson have been elected Vice-Presidents, and Mr. Cyril E. Lloyd, M.P., and Mr. H. Spence Thomas have been elected Members of Council during the year. The Rt. Hon. Lord Airedale and Mr. Andrew Lamberton have retired from their offices as Vice-Presidents, and have been elected Hon. Vice-Presidents of the Institute. In accordance with Bye-law 10, the names of the following Vice-Presidents and Members of Council were announced at the autumn meeting as being due to retire at the annual meeting, 1927: *Vice-Presidents*—Mr. F. W. Harbord, Mr. M. Mannaberg, Colonel Sir W. Charles Wright. *Members of Council*—Mr. H. Brearley, Mr. A. Dreux, Mr. A. Hutchinson, Mr. W. Simons, Mr. V. B Stewart. Mr. Harbord has since been nominated for the Presidency, and Professor H. Louis being next due to retire, now retires in his place. Mr. Brearley and Mr. Hutchinson have been elected Vice-Presidents, and Mr. J. Henderson and Professor T. Turner accordingly retire in their places. No other members having been nominated up to one month previous to the annual meeting, the retiring members, in accordance with the announcement made at the autumn meeting, but subject to the changes specified, are presented for re-election.

The report of the Council was adopted.

The retiring President having vacated the chair, it was occupied by the new President (Mr. F. W. Harbord) amid applause.

A vote of thanks was unanimously accorded to Sir W. Peter Rylands for his services as President during the past year.

The new PRESIDENT, after thanking the members for his election, then proceeded to deliver his Presidential address as follows:—

Presidential Address.

Since the introduction of the Thomas Gilchrist basic process, which revolutionised the steel industry of the world, there has been no fundamental discovery which has materially affected the steel industry as a whole. There have been many important and far-reaching developments introduced both in plant equipment and practice, but these have generally been in the direction of improved design and construction, of improved methods of generating and utilising power, and in the installation of modern equipment for handling large quantities of raw and finished materials with less expenditure of labour. On the operating side important advances and improvements have been made by increased by-product recovery in the coke-ovens, by increased output and reduction in fuel consumption in the blast furnaces, and in steelworks practice by the introduction of the Talbot and other processes. The increase in the world's consumption of iron and steel has been so great that it has only been possible to meet the demand by increasing the size of the operating "unit," whether blast furnaces, open-hearth furnaces, power plants, or mills.

So far as we can see at present there is no indication of any new process, either in iron or steel manufacture, which is likely to revolutionise our present methods of production, and such improvements as may be possible must be affected by the necessary modifications in plant at a minimum cost and by giving greater attention to detail in working, so that our plants may be operated to produce the maximum output and give the highest possible yield with the minimum consumption of fuel and labour per ton of output.

Notwithstanding the enormous developments in modern industry and the immense increase in production of all commodities between the years 1890 and 1912, the average world's selling price of all commodities taken together rose approximately 25 per cent. In this generalisation is included not only manufactured goods but all foodstuffs, and if these latter and all natural products other than minerals had been omitted, the average rise in price of manufactured goods would have been much more than 25 per cent.; the price of some rose more than the 25 per cent., some less, and a few, but very few, actually decreased in price. Amongst some of those that showed an increase in price above the 25 per cent. were:—

Pig-iron	... ...	30	per cent. (approx.)
Copper	.. ...	52	,, ,,
Tin	... ...	132	,, ,,

I have taken the above pre-war period, ending at 1912 to avoid including abnormal fluctuations in prices due to the war. The large increase in copper and tin was principally due to the demand exceeding the supply—a condition which has not affected the steel industry to any appreciable extent.

The average quoted prices for pig iron and steel rails in Europe and America for the periods 1891 to 1895 and 1908 to 1912 were as shown in Table I. It will be noted that the average prices of American and German rails for the five years 1891-95 were practically the same as the average price of the British rails for the five years 1908-12.

TABLE I.—*Prices of Pig-Iron and Steel Rails.*

	Average five years, 1891-95.	Average five years, 1908-12.	Average five years, 1891-95.	Average five years, 1908-12.
	Pig-iron.	Pig-iron.	Rails.	Rails.
British ..	£2 6s. 6d. (Hematite)	£3 4s. 4½d. (Hematite)	£4 1s. 6½d.	£5 13s. 8d.
Cleveland ..	£1 17s. 1d.	£2 11s. 3½d.		
American ..	£2 16s. 1d. (Bessemer pig acid)	£3 9s. 6d. (Bessemer pig acid)	£5 13s. 8d.	£5 16s. 8d.
German ..	£2 12s. 6d.* (Hematite)	£2 19s. 1d. (Hematite)	£5 13s. 9½d.	£6 1s. 9d.
Belgian ..	—	—	£4 2s. 8d.	£5 8s. 0d.

* For the four years 1891, 1892, 1893 and 1895; figures for the year 1894 were not available.

This was largely due to the fact that the iron and steel industry was only beginning to develop on modern lines in both these countries in the late 'eighties and early 'nineties. Both of these countries, by the erection of modern plants, with improvements based largely on our experience, and by the development of their iron ore and coal resources, were able to reduce their working costs sufficiently to enable them to produce rails in 1908-12 at little above the average price for 1891-95, notwithstanding the general increase in the price of raw materials. The development of the steel industry in America was assisted partly by protective duties and largely by the special conditions of her home market; the invention of the basic process made available for the German manufacturers all the phosphoric ores in the Alsace-Lorraine district, and rendered possible a great German iron and steel industry.

The selling price depends on the cost of production, which in the case of pig-iron includes the following items: raw materials, including ore, limestone and coke, refractories, labour including productive and repair work, technical and general supervision and management, office and selling charges, repairs, depreciation of plant, general overhead charges, such as rent, rates, taxes, insurance, social charges, etc.; the selling price is the sum of the above, plus such profit as the consumer will pay. All these charges during the period under consideration have followed the general trend and increased with the price of commodities, which explains the increase in the price of pig-iron and steel. I propose to refer to two only of the above items—in the first place, very shortly to raw materials, and, in the second place, in greater detail to charges for depreciation and repairs as affected by capital expenditure on plant.

Curves were submitted showing the variations in prices of Durham coal, coke, and limestone, Cleveland ore and Cleveland pig-iron, and rails for the years 1890-1912. Similar curves showed variations in prices of Rubio ore, hematite iron, American ores, and American and German and Belgian pig-irons and rails for the same periods, so far as these are available. The percentage of iron in the ironstone in most cases decreased during this period, necessitating the smelting of a larger quantity of ore to produce a ton of pig-iron, but on the other hand, coke consumption per ton of pig-iron decreased. Any increase in wages in respect to raw materials is included in the increased price of the materials.

In comparing the costs of pig-iron, rails, etc., with other commodities, it must be remembered

that the iron and steel industry, in common with other metallurgical industries, is in a special position in respect to the supply of raw materials. All our raw materials—ore, coal, and limestone—are fixed as regards position, and are wasting assets, and consequently the cost of these in any given locality tends to increase as the deposits are worked to a greater depth, and gradually become exhausted. In addition, the percentage of iron in the ore may, and frequently does, decrease as working proceeds, and either exhaustion, or a serious falling off in quality, may necessitate obtaining new supplies from distant mines, involving an unknown increase in costs.

An examination of the curves will show that, so far as English prices are concerned, the selling price of the finished products and the cost of the raw materials vary together, following each other closely, and this increased cost of materials has very considerably affected the cost of the finished steel.

Capital Expenditure.

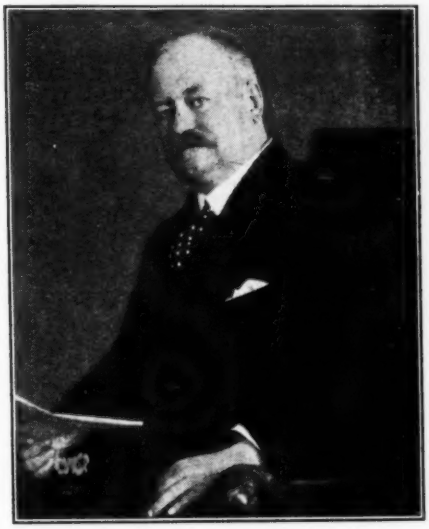
I wish, however, more particularly to direct your attention to the heavy increase in capital expenditure between 1890 and 1912, which was necessitated by the demand for large quantities of iron and steel, and the extent to which the charges both for repairs and depreciation have increased the cost of production. The cost of repairs, we know, increases as the expenditure on the plant increases, but not in any definite ratio, and will vary within such wide limits, depending upon the particular plant, that I have made no attempt to estimate it separately, but have included it with depreciation charges.

The capital cost of a completely balanced iron and steel plant in 1890, which can be fairly compared with a plant built about 1910-12, is extremely difficult to obtain with any degree of accuracy; complete open-hearth plants with coke ovens, blast furnaces, mills, etc., did not exist in 1890, or at all events were not erected as complete plants, but were built up gradually by making additions from time to time. I have, however, been able to obtain from a number of different sources the cost of separate units, such as coke ovens, blast furnaces, open-hearth furnaces, etc., at the different dates, and by comparing these built under different conditions I have, I believe, been able to arrive at a very close approximation to the relative cost of a complete plant in 1890 and 1912.

I estimate that about 1890 a complete iron and steel plant in this country designed for rolling rails and sections with all accessories—railways, water service, loose tools, etc.—cost about £4 to £4 10s. per ton of output of finished rails or structural steel, and that the actual costs of a similar plant in 1910-12 was about £6 10s. to £7. The costs vary in different districts and with different sites, depending upon foundations and other local conditions, and I have detailed costs of plants built about 1912 which give a considerably higher figure than £7 per ton. I think if we take £4 5s. per ton for 1890 and £6 15s. for 1912, we shall be well within the mark, for if anything the difference in costs between the two dates is greater than this. In America the cost of a modern iron and steel plant complete with blast furnaces in 1910-12 was dis-

Professor Carl Benedicks.
(Bessemer Gold Medallist.)

Carl Axel Fredrik Benedicks was born at Stockholm in 1875. He is the son of E. Otto Benedicks, iron works manager, and a nephew of the well-known Swedish metallurgist, Dr. Henrik Tholander. He graduated from the Beskowska Skolan at Stockholm in 1893, entering the University of Upsala in the same year. He obtained the degrees of Fil. Kand in 1896; Fil. Lic. in 1902; and Fil. Dr. of Upsala University in 1904. His Doctor's Thesis, "Recherches Physiques et Physico-Chimiques sur l'Acier au Carbone," in 1904 received widespread recognition. His first appointment was that of demonstrator at the Physical Institution of Upsala University. In 1904 he became University Lecturer in Physical Chemistry; in 1911 he was appointed Professor of Physics at the University of Stockholm; and in 1920 became Director of the Metallographic Institute of Stockholm, which position he still holds. Professor Benedicks has studied extensively abroad. In 1904 he spent a considerable period in the United States, and in 1925, at the invitation of the American Institute of Mining and Metallurgical Engineers, he gave a course of lectures in the United States. Among the many honours conferred upon him are the following:—Hon. Member of the Scientific Student Association of Upsala, 1911; Corresponding Member to the Council of the Institute of Metals in 1914; Member of the Royal Academy of Scientific and Industrial Research, Stockholm, 1919; President of the Swedish Metallographers' Association, 1921; Hon. Vice-President of the Iron and Steel Institute, 1922; Member of the Royal Society of Upsala, 1922; and Member of the Swedish Academy of Science, Stockholm, 1924. He was awarded the Bergstedt Prize in 1902; the Edlund Prize in 1904; the Carnegie Gold Medal of the Iron and Steel Institute in 1908; the Arnberg Prize in 1919; and the Prix Henry Wild of the Académie des Sciences, Paris, in 1922. Professor Benedicks is the author of a large number of scientific and technical papers. He has made many important contributions to the proceedings of the Iron and Steel Institute, including one at the present May meeting. In 1920 he gave the May lecture before the Institute of Metals.



Axel F. Wahlberg.
(Bessemer Gold Medallist.)

Axel Fredrik Wahlberg received his early training at the Royal University at Stockholm, and graduated from that institution as mechanical engineer in 1890; he also went through a course at the Royal Mining School at Stockholm, graduating as mining engineer in 1891. His first appointment soon followed at the Sandvik Steel Works, where he held the position of Superintendent of Blast Furnaces and Steel Plant from 1892 to 1895. He left Sandvik in 1896 to become Director of the Government Testing Institute at Stockholm—a position which he held until 1903. Simultaneously he held a Professorship at the Royal University, and from 1899 to 1903 acted as Chief Editor of the *Jernkontorets Annaler*. In 1903 Mr. Wahlberg left Stockholm to take up the position of General Superintendent at the Fagersta Steel Works, of which at that time J. A. Brinell was General Manager. On the appointment of Mr. Brinell as Chief Technical Adviser to *Jernkontoret* in 1907, Wahlberg succeeded him as General Manager of Fagersta. On Brinell's retirement seven years later, Wahlberg again succeeded him in the position of Chief Technical Adviser to *Jernkontoret*. Combined with technical ability of a high order, Mr. Wahlberg early showed that he possessed considerable diplomatic talent, of which not only the Swedish Iron Institute, with which he was associated, but also the Swedish Government have frequently availed themselves. He is a member of the Board of Directors of the Royal University, President of the Board of Directors of the Government Testing Institute at Stockholm, member of the Board of Directors of the Metallographic Institute, and a member of the Royal Academy of Scientific and Industrial Research. Finally, since 1923 he holds the appointment of Consulting Engineer to the Swedish State Railways. He has submitted several Papers to the Iron and Steel Institute.

XUM

tinctly higher than in this country, and is given by different engineers as from £9 to £10 per ton of output; some give an even higher figure.

Based on the assumption that the capital costs were £4 5s. in 1890 and £6 15s. in 1912 per ton of output, and taking the low figure of 8 per cent. to cover both repairs and depreciation, it means that the charge for depreciation was 10s. 9d. per ton of output in 1912, as against 6s. 9d. in 1890—an increase of 4s. per ton. This shows an increase of 58.5 per cent. in depreciation and repair charges per ton of finished product during 1890-1912, and is equivalent to 3 per cent. on the capital invested in 1912. The charge of 10s. 9d. per ton for depreciation and repairs on every ton produced includes nothing for interest on the capital invested, and if we include the modest return of 5 per cent. for this, the charge per ton of product becomes 17s. 6d., whereas the charge in 1890 would have been only 11s. per ton. This does not allow for any interest on working capital as distinct from capital invested in plant.

The increase in capital cost is to some extent explained by the general rise in prices of all materials, but when allowance is made for this, I think, in view of the great increase in output, we might reasonably have expected that the capital cost *per ton of output* would have decreased between 1890 and 1912. This capital charge of 17s. 6d. per ton refers to 1912, and, in view of the large increase in costs of plant since that date, it would be so much higher to-day that this question of keeping down capital expenditure is of very much greater importance than it has been at any time in the history of the industry.

The effect of increase in capital expenditure is further emphasised if we consider the time required to turn over the capital. With every increase in capital cost per ton of output, the time required to turn over the capital is increased and the earning power is correspondingly reduced.

Expenditure on plant may be justified if it reduces manufacturing costs either directly by the reduction of labour costs, the reduction of the quantity of materials required, the increase in the output or the improvement of the quality of the product, or indirectly by the improvement of the working conditions. In some cases the demand for an improvement in quality or a greater variety of products may justify increased capital expenditure, even when there is not only no decrease in working costs but an actual increase. The gradual replacement of the basic-Bessemer process by the basic open-hearth process, which is the present tendency all over the world, is a case in point, as notwithstanding the increased cost both in capital expenditure on plant and in manufacturing costs, the greater control in respect to the quality and the greater elasticity of the open-hearth process has justified the change.

Another case is that of the replacement of the old beehive coke oven by the modern by-product coke-oven plant. The capital cost of the modern coke-oven plant per ton of annual production was in 1912 about 13s. per ton as against 3s. per ton for the old beehive type of oven, but the greatly increased yield of coke, the recovery of by-products and general reduction in working charges, have justified the increased expenditure.

I fully realise that very large expenditure has been and must always be necessary in a progressive industry, and that it is absolutely essential, if we are to hold our own in competition with the world, that money must be continually spent not only to maintain and improve the efficiency of our existing plants, but also to erect new plants to keep pace with new developments. The real question, however, is not the actual expenditure, but the relation which the expenditure bears to the costs of production, which latter are so appreciably affected by the charges for depreciation and repairs.

I submit it is a reflection on steelworks practice that not only in this country but all over the world, notwithstanding the very greatly increased outputs, the capital cost per ton was considerably higher in 1912 than in 1890; and it is a matter deserving the most serious consideration that it has not been possible to build a works embodying all the essentials for the most economic production, at a cost *per ton of output* in 1912 at least approximating to the costs in 1890.

There is no doubt that unnecessary expenditure has frequently been incurred, due to insufficient consideration of the effect that alterations, if carried out, would have on the balanced operation of the plant as a whole; often allowance has not been made for the additional expenditure on the other parts of the plant which would be necessary before it could be operated with real efficiency. The difference between what is essential as distinct from what is desirable has frequently not been fully realised. There has been a tendency to duplicate plants either in whole or part which are giving good results in other countries, without fully considering whether equally good or even better results could not be obtained under our special conditions at a smaller capital cost.

Defects in Iron and Steel Plants.

In my opinion a very common, if not the most common, defect in iron and steel plants is the lack of balance. It is not unusual for so much money to be spent, often far more than is necessary, on one part of the plant that it is impossible, for financial reasons, to carry out the original intention of modernising the plant as a whole. We find plants in which the open-hearth and mills are of latest design equipped with the most modern appliances, while the coke ovens and blast furnaces are insufficient in number to meet the requirements of the steel plant, or are old and working under conditions which make it impossible to produce pig-iron economically. On the other hand, though more rarely, the coke ovens and blast furnaces may be thoroughly up to date, while the steel or mills are inefficient.

Sometimes the lack of balance is not so much in the plant as a whole, but one or more of the departments, considered as a separate unit, is out of balance. Thus we have blast-furnace plants poorly equipped for handling raw materials, deficient in blowing power, or without gas-cleaning plant. Both open-hearth and blast-furnace plants are often greatly handicapped by inadequate provision having been made for maintaining a regular supply of raw materials, and the efficiency of the plant as a whole is often considerably reduced by the insufficient cleaning of the blast-furnace gas, and by unsuitable arrangement of the mains for the best distribution of the surplus gas.

In a well-balanced modern plant the gas from the coke ovens and blast furnaces, if utilised under the best conditions, should be sufficient to supply all the fuel required for operating the steel plant, and this to my knowledge is being done at several basic-Bessemer plants and at least one open-hearth works on the Continent. This necessitates cleaning the blast-furnace gas, and burning it in specially designed burners to ensure complete combustion with the minimum quantity of air, so that the maximum heating effect is obtained in the hot-blast stoves, reheating furnaces, or under boilers. The cleaning of blast-furnace gas is a matter which I consider has not received the attention it should have had, and many of our works are still burning dirty gas in hot-blast stoves and under boilers, incurring not only loss in fuel, but in many cases greater indirect losses in destruction of refractories, in labour, and in repair charges, etc. Another direction in which fuel can be saved is by installing waste-heat boilers in connection with our open-hearth or other furnaces; for if we are to approach the ideal condition when our plants will be self-contained as regards fuel, it will be necessary to utilise every heat unit.

If these economies are to be effected some expenditure will be necessary; but in many cases this will be comparatively small, and will pay for itself in a very short time.

Whether I am right or wrong in thinking that our capital expenditure per ton of finished material has been too high, we are faced to-day with the fact that heavy capital expenditure has been incurred. Short of building new plants, all we can do now is to make such additions and alterations to our most modern plants as are absolutely necessary to ensure efficiency, and to utilise these plants to the best advantage, and I think we may usefully consider whether everything possible is being done in this latter direction.

Steel-Plant Materials.

In a modern steel plant, if it is to operate to the best advantage, it is essential that the most suitable material must be supplied for use in each department. Thus coke which will give the best results in the blast-furnace, suitable coal for the producer, suitable pig-iron for the open-hearth, ingots to nearest possible weight to meet the particular requirements of the mill at the moment, should be supplied.

On the Continent it is a common practice regularly to supply pig-iron for the basic Bessemer and open-hearth furnaces with 0.5 per cent. or less of silicon and low in sulphur, whereas in this country, so far as I know, there are few if any open-hearth furnaces which are *regularly* operating on special pig-iron of this composition. I am fully aware that with some of our ores it is particularly difficult to make a low-silicon and low-sulphur iron, and that it will cost more to make; but I am also aware that such an iron costs far less to convert into steel. Although there may be great difficulties, I am not prepared to admit it is impossible to produce such pig-iron even from Cleveland ore. To produce such a pig-iron regularly will necessitate the use of some manganiferous ore, and, what is very important, the crushing and sizing of the iron ore to pass a 3-in ring, and the most careful control of the furnace operations. It will require the closest attention to ensure the proper mixing and regular charging of the ore burden, careful adjustment of the limestone to give a free-running slag with a high lime content, and the most careful control of the temperature and volume of blast.

The advantages of such a pig-iron from the open-hearth manager's point of view are obvious, as it means saving not only in fuel, fluxes, and refractories, but improved quality of product and larger output. I know that opinions are divided as to the advisability of spending money at the blast furnaces to produce a suitable pig-iron as against spending money in the open-hearth to do the work which should, in my opinion, be done at the blast furnace, and this may be to some extent a matter of special conditions. In view, however, of the general Continental and, I think I may say, the general American opinion, as expressed in their works practice, that it pays to supply the steel department with a low-silicon, low-sulphur iron, I submit that this question should be most carefully reconsidered, to see if on balance there is not more to be gained by the blast-furnace producing a special iron of this kind, rather than by requiring the open-hearth department to use a pig-iron which admittedly is not best suited for the purpose.

In our general blast-furnace practice I believe considerable improvement is possible by following the American practice of blowing by volume instead of by pressure, by crushing the ores to pass a 3-in. ring, and by giving greater attention to detail in charging the furnace, to the combustion of the gas in hot-blast stoves, and to controlling the temperature of the blast.

Fuel Consumption.

In the open-hearth steel department there is still room for reduction in fuel consumption, by production of better and more regular gas, and also by the burning of the gas to greater advantage. Both these are largely questions of attention to detail, in operating the producer, and in regulating the combustion of the gas in the open-hearth furnaces. By the selection of suitable fuel reasonably low in ash, by systematic analysis of the gas, and by the careful regulation of the air and steam supply, not only can the composition of the gas be controlled within narrow limits, but, what is more important, a regular supply of suitable gas can be maintained. By the regulation of the gas and air valves in the open-hearth furnace to ensure that not only the maximum heat is being developed by the combustion, but that more gas is not being used than is required for maintaining the necessary temperature during the different periods of working of the charge, the quantity of gas used can be considerably reduced.

The production and economic use of gas is of such importance that I am convinced that it would pay many of our works to have a highly-trained technical man to act as fuel superintendent, who should devote his whole time to the supervision of the gas production and its effective combustion in the open-hearth, the mills, furnaces and under the boilers. A saving of 25 tons of coal per week would pay his salary. It would require a man of exceptional qualifications, as each departmental manager must necessarily have control of his own furnaces, and unless the fuel superintendent had great tact and was able to gain the confidence and enlist the co-operation of the departmental managers, it would be impossible for him to obtain really satisfactory results.

To obtain good results fuel suitable for gas production must be supplied, and before contracts for coal are placed the fuel superintendent, or whoever is responsible for the producers, should be consulted as to which fuel obtainable in the district gives the best results. The mechanical conditions, the type of coal, whether free-burning or coking, should be considered, in addition to the percentage of ash present.

While the technical man on the one hand must recognise that the most expensive coal is not necessarily the best for his purpose, the purchasing department on the other hand must realise that the lowest-priced coal is not necessarily the cheapest. In my experience much money has often been wasted in buying what is considered a cheap coal when a better coal at an extra 6d., or in some cases 1s., per ton would frequently have paid for itself in lower ash content alone, and many times over in labour, repairs, and, what is of greater importance, in the regular supply of good gas upon which the efficiency of the open-hearth plant so greatly depends. There is the same necessity for consultation between the purchasing department and the departmental managers of the coke ovens, blast furnaces, and open-hearths, before placing contracts for raw materials, etc., and intelligent and close co-operation in this respect is essential to ensure real economy.

Another matter which does not always receive the detailed attention which it deserves is the yield both from the open-hearth furnace and the mills. From records received from different works, in the case of rail mills, I find that the yield of good rails per ton of ingots rolled was no greater in 1912, and I think I may say is no greater to-day, than it was in the early 'nineties. It may be that the present yield is as much as can be obtained under the specifications to which we have to work, but it seems far from satisfactory that the yield has not increased since 1890, and I think there are possibilities of improvement in this and other directions by more systematic control and closer attention to detail.

Size of Plant.

The economic production of iron and steel depends upon many factors, and amongst others one of the most important is the size of the plant.

It has been stated by men of wide experience that to compete successfully under modern conditions, a plant producing rails and structural steel must have an output of at least 10,000 tons of finished material per week, and some insist upon an even larger output. This may be true in countries like America, where the home market is a very large one and able to absorb the greater part of the production, but I am extremely doubtful about it being true in this country. The economic size of the plant largely depends upon the special conditions, and provided the output is large enough to carry the necessary overhead charges to maintain a staff of the best technical and commercial men available, this is the factor which largely determines the economic size; little if anything is to be gained by increasing the size of the plant when this condition is met. When a works increases above a certain size the efficient control becomes more difficult and leakages are liable to occur, and unless it can be kept operating at or near its full capacity, the capital charges and the increase in manufacturing costs become a most serious matter. What is really more important than the size of the plant is that it should be well balanced, so that it is as self-contained as possible, and that it should specialise in one particular class of finished material. I suggest the ideal combination would probably be a group of works, each works being specially designed to produce a particular product,

XUM

such as rails, sections, billets, sheet bars, plates, etc., each managed independently as a separate unit, and of such a size that each could carry overhead charges sufficient to enable the best men available to be secured both for commercial and technical management, but all the works being linked up to a central purchasing and selling organisation. Under such an arrangement the success of each works would depend upon its efficient management, and it would be possible to operate in normal times to something approaching full capacity under the most favourable manufacturing conditions. All competition for orders for the same material would be eliminated, and the only competition between the different works would be to see which could show the best balance-sheet. To ensure success it would be absolutely essential that arrangements should be made to obtain the control of raw materials sufficient to meet, if not in full, at least in part, the requirements of each of the works, so that the combination to a large extent would be independent of outside supplies.

How far it would be possible for some of our existing works in the same districts, without any large expenditure of capital, to modify their plants so that they could specialise on one product and link up under some such scheme and still remain separate entities, it is not for me to say; but the advantages from the manufacturing point of view of each works concentrating on one product are too obvious to need comment.

Conditions have changed during the last forty years; the modern works is not now a works carrying out one operation, but a combination of works, and the key to success is an organisation which will ensure the closest co-operation between the departmental managers. These men must not regard their departments as separate units, but as integral parts of the whole, and each must realise that the one thing essential is to subordinate his particular department to the interest of the works, the object being by the most effective team work to produce the maximum amount of finished material of the highest quality at the minimum cost. A real *esprit de corps* amongst the staff does not end with the staff, but rapidly permeates the whole labour organisation and influences every man in the works.

In the past our great industry was built up by the ability, industry, enterprise, and courage of the ironmasters and the technical men associated with them. Although manufacturing conditions have changed one thing remains the same—the success of the industry still depends, and must always depend, upon the men who control it.

To face the competition of the future the industry will need men of the greatest ability the country can supply; on the technical side, highly-trained men whose practice is based upon experience controlled by sound theoretical knowledge, and on the commercial side highly-trained men with a wide knowledge of fundamental business principles. It is for those at present in control to offer such a career, both on the technical and the commercial side, as will attract the most capable young men in the country, so that the future captains of our industry may be trained men of affairs, with knowledge, sound judgment, and a sense of proportion which will enable them to subordinate the part to the whole, and so ensure that co-operation between the different departments which is absolutely essential to success.

On the motion of SIR PETER RYLANDS, a vote of thanks was accorded to the President for his interesting Address.

Presentation of Bessemer Medals.

During the proceedings the PRESIDENT presented the two Bessemer Medals which had been awarded by the Council. He explained that it was usual to present one Medal annually, but on one or two exceptional occasions, when, in the opinion of the Council, two men working independently had in different ways equally contributed by their work to the progress of the industry, two Medals had been given. Such an occasion had arisen that day, and it was felt by the Council that full recognition of the great work of Swedish metallurgists could only be adequately given by conferring two Medals, one on Mr. Wahlberg, as representing the more practical side, and the other on Dr. Benedicks, as representing scientific metallurgical research.

MR. AXEL WAHLBERG, in acknowledging the presentation, said he considered it as a wonderful tribute to Jernkontoret and to what that Institution had achieved for nearly two centuries past in the advancement of scientific and practical metallurgy.

PROF. C. BENEDICKS recalled the interesting fact that the first Bessemer Medal was given in 1874 to Sir Lowthian Bell, and the last one to his son, Sir Hugh Bell, in 1926. He went on to say that if it had been possible for him (Dr. Benedicks) to do anything of value concerning metals it was no doubt due to an early family contact with the iron industry. There were few regions of human work where advances were so dependent on a sound tradition, on a continuous development of the social structure, on the very environment, as was the case with iron and steel. He thought that was the reason why such a distinguished British corporation as the Iron and Steel Institute had been able to do such an enormous amount of work in advancing progress.

United States Pig-Iron Output, 1926.

According to Statistical Bulletin No. 1, 1927, just issued by the American Iron and Steel Institute, 39,372,729 tons (of 2,240 lbs.) of pig-iron and ferro-alloys were made in the United States last year (compared with 36,700,566 in 1925). Of the total output 38,698,417 (36,116,311) tons were pig-iron and 674,312 (584,255) tons were ferro-alloys. According to kinds 21,168,407 (19,667,380) tons were basic iron, 10,042,324 (9,419,461) tons Bessemer and low-phosphorus iron, 5,506,968 (5,183,745) tons foundry iron, 1,681,897 (1,553,636) tons malleable pig-iron, 216,277 (240,652) tons forge iron, and 82,544 (51,437) tons were other kinds of pig-iron. The output of ferro-alloys included 318,891 (260,029) tons of ferro-manganese, 76,215 (65,755) tons of spiegeleisen, 245,605 (226,472) tons of ferro-silicon, and 33,601 (31,999) tons of other kinds of ferro-alloys.

All pig-iron and ferro-alloys are included, whether made in blast furnaces or in electric furnaces. Pig-iron made with bituminous coal is included under coke pig-iron. Pig-iron made with mixed anthracite and coke is included in anthracite pig-iron. Pig-iron made with electricity is included in coke pig-iron.

Low-phosphorus pig-iron, that is, iron running under 0.04 per cent. in phosphorus, is included in Bessemer iron. Pig-iron containing from 0.04 to 0.10 per cent. of phosphorus is classified as Bessemer. The returns for 1913 and subsequent years include under basic iron a small quantity of charcoal iron of basic grade. In 1912 and prior years charcoal pig-iron of basic quality was not included in the basic production. Nearly all the charcoal iron is classed as foundry pig-iron. Under all other kinds of pig-iron are included white and mottled, miscellaneous grades of pig-iron, and direct castings.

According to methods by which pig-iron and ferro-alloys were cast or delivered, 25,243,551 tons were delivered in a molten state, 1,811,476 tons were sand-cast, 11,721,519 tons machine-cast, 561,137 tons were chill-cast, and 35,046 tons were direct castings.

According to fuel used, 38,534,537 tons were coke pig-iron and 163,880 tons were charcoal iron.

The number of furnaces in blast on December 31, 1926, was 199 (compared with 213 on June 30 last year) out of a total number of 358.

Of the total output of pig-iron last year, 9,288,449 tons were made for sale and 29,409,968 tons for the makers' own use. Of the ferro-alloys, 471,811 tons were made for sale and 202,501 tons for the makers' own use.

H. H. Vivian & Company, Limited.—The annual meeting of shareholders was held in Birmingham on April 28. MR. DOUGLAS JOHNSTONE presided, and in moving the adoption of the directors' report, said the hopes with which they started the year were soon crushed by the terrible coal strike. Their business was very much dependent upon heat, and they were very badly hit by the enormous increase in the cost of fuel. Mr. W. Wellesley Wood, who seconded, said it had been a very anxious and difficult year, and they were lucky they had not been hit harder.

Carbon and Silicon in Cast Iron.*

By A. E. Allinson.

Carbon and silicon may be considered to be by far the most important elements in their effects on cast iron. Carbon is somewhat of a nuisance inasmuch as the total contents are concerned. It is, however, of high importance, but is very difficult to control. Cast iron may be considered as being steel containing interruptions of graphite. These interruptions in structure produce that difference in mechanical and physical properties

Other elements frequently unnoticed must, of course, make some contribution, however small, to the total properties of the metal, viz., copper, titanium, vanadium, chromium, all of which are frequently present in cast iron. Derbyshire iron has been found to have 0.26 per cent. titanium and vanadium, titanium preponderating.

All elements become more powerful in their effects the further the metal is from being pure

FIG. 1.

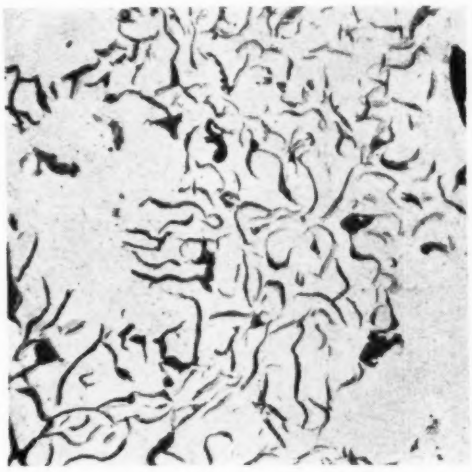


FIG. 2.

FIG. 3.

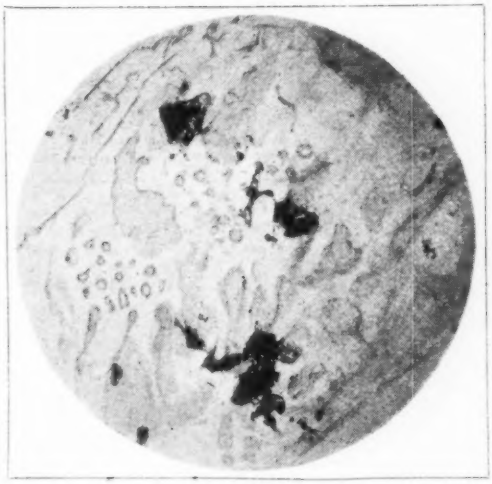


FIG. 4.

FIGS. 1, 2 AND 3 SHOW RESPECTIVELY LARGE, CURLY AND SPOTTED GRAPHITE × 100. FIG. 4 SHOWS SULPHIDES IN THE CHILL OF A CHILLED ROLL. THE CHARACTERISTIC SHAPES PRESERVED THROUGH THE RAPID COOLING APPEAR TO BE EVIDENCE OF THE DECIDED AFFINITY OF THE MANGANESE FOR THE SULPHUR FIRST, AND POSSIBLY ALSO THAT THE SULPHIDES FALL OUT OF SOLUTION WHILE THE METAL IS STILL LIQUID, × 300.

from those possessed by steel of similar aggregate as regards ferrite and pearlite.

In this connection, before dismissing the other usual elements found in cast iron from consideration, it may be said that manganese ranks next in importance in its effect upon the material. Sulphur, provided there is excess of manganese over its requirements to form manganous sulphide, is dormant as inclusions which act similarly to graphite inclusions but much less in volume. Phosphorus forms the more bulky phosphide eutectic, but within limits, since it appears to possess a certain amount of mechanical strength, does not under certain conditions appear to affect greatly the properties of the iron.

* A Paper read before the Sheffield Branch of the Institute of British Foundrymen, Mr. Geo. Edginton presiding.

iron. Thus 0.5 per cent. chromium has some effect in a mild steel, more as the carbon increases, and how much in cast iron is well known. Vanadium 0.1 per cent. has a decided influence in mild steel. The table illustrates this point. In the case of the casting the chromium was added intentionally, but the total effect of other elements cannot be ignored. The effect, therefore, of any element in a rich alloy like cast iron must be very pronounced.

One point which requires careful attention is the question of methods of analysis. Owing to the metal drillings being coherent, and the graphite and possibly phosphides falling away as powder, it is necessary to weigh out for analysis a well-mixed portion as the sample, and it is better to rub the drillings down to coarse powder

before weighing out. At all events, one feels that analyses are not always reliable in spite of well-tried methods, and therefore frequent duplicates are desirable.

Table I.—*Analysis of Irons, including Rarer Elements.*

	C	Si	Mn	S	P	Cr	Ti	V	Cu
Hematite ..	—	—	—	—	—	0.24	—	—	0.10
.. ..	—	—	—	—	—	0.26	—	—	—
.. ..	—	—	—	—	—	0.37	—	—	0.17
.. ..	—	—	—	—	—	Nil	—	—	0.10
.. ..	—	—	—	—	—	Nil	—	—	0.10
.. ..	—	—	—	—	—	0.27	—	—	0.08
.. ..	—	—	—	—	—	—	—	—	0.30
.. ..	—	—	—	—	—	—	—	—	0.41
Foundry irons	3.37	2.40	1.45	0.045	1.11	0.14	0.33	0.12	—
.. ..	—	3.95	1.28	—	1.17	0.04	0.18	0.36	—
.. ..	—	4.25	0.92	—	1.29	—	0.24	0.21	—
Casting ..	2.85	1.55	0.56	0.076	0.44	0.34	0.09	0.03	0.06 and Ni 0.09

One of the most notable discoveries is that the best properties of cast iron are associated with low total carbon. The critical point is about 3.4 per cent. This is no real critical point, but one might say that with total carbon higher than this weakness is liable to result.

High tenacity and toughness in cast iron have been shown to be largely, if not altogether, dependent upon the size, shape and arrangement of the graphite flakes. Graphite occurs in three forms, flakes, curly flakes and spots. Examples are shown in Figs. 1 to 3. Even the large flakes are often seen to have a curly arrangement if examined at a low power; in other words, they are large and curly, while sometimes one gets very small curly flakes.

Spots of graphite are usually found in malleable iron which is quite reasonable, since the carbon therein is thrown out of combination by annealing and not precipitated from solution. It is also stated that the new methods of casting centrifugally results in spotty graphite, which is a quite likely result from the agitation of the metal in solidifying. Before going further, it is necessary to consider what happens in the cooling of cast iron from molten to cold. The metal as a whole freezes or solidifies between 1,180 and 1,200 deg. C. The phosphide eutectic is still liquid,

Fig. 5.—Characteristic Phosphide Eutectic × 300.

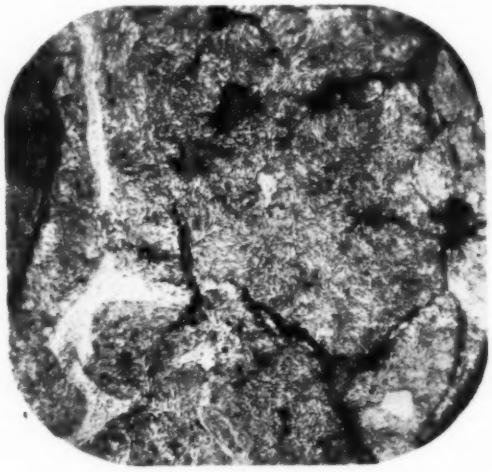


Fig. 6.—All Pearlitic Iron. (TC 3.49; Si 1.16; Mn 0.52; and P 0.59 per cent.) × 300.

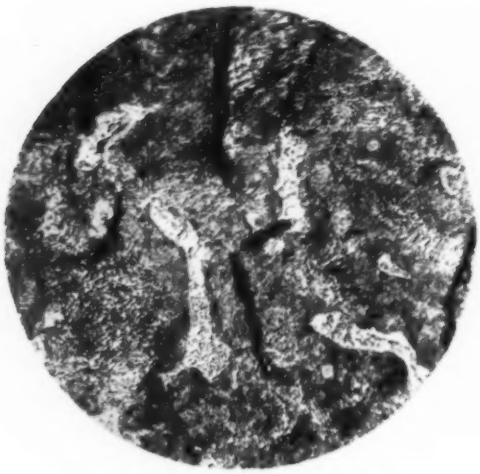


Fig. 7. Pearlitic Iron (C 3.12; Si 1.49; Mn 0.69; and P 0.46 per cent.) × 300.

Fig. 8.—Pearlitic Iron (C 3.25; Si 1.73; Mn 0.58; and P 0.67 per cent.) × 300. In this Case the Metal is on the Analysis Limit, since some Ferrite is to be Seen.

and possibly the manganese sulphide has been precipitated.

Carbon, with which we are concerned for the present, is all in solution until a temperature of 980 deg. C., when graphite precipitation commences. This process is continuous because the graphite flakes have obviously grown. Also curly graphite seems to indicate that the graphite flakes, in growing, have to find a path round nuclei of pearlite. Possibly also growing upon carbon ejected from the nuclei contributes to the circular shape. This is in a similar way to the phosphide eutectic which has obviously been formed between growing nuclei, its shape being reminiscent of the paste from which circles for jam tarts have been punched.

Continuing the cooling further, it would appear that the proportions of pearlite and ferrite depend upon two factors, the casting temperature of the metal and its silicon content.

The Effect of Silicon.

Iron and silicon are mutually soluble in all proportions, so that under the microscope, silicon is not seen, being dissolved in the ferrite of iron and steel. The effect of silicon is only moderate compared with some elements, except its property of degasifying by forming an insoluble and irreducible oxide. The effect of all elements in pure iron is increased as the carbon increases, so that in a rich alloy like cast iron the moderate effect of silicon becomes fairly powerful. The sole effect of silicon is to reduce the solvent power of the ferrite for carbon. In other words, the silicon dissolved in the ferrite expels carbon in cooling, causing the latter to be precipitated as graphite, just like sugar candy may be formed from a saturated solution of sugar as it cools.

It is quite in keeping with chemical and physical laws that the precipitation of graphite by silicon should be in proportion to their respective amounts. Thus high carbon content with high silicon content means much coarse graphite and a very grey iron. Low carbon contents with low silicon means little if any graphite precipitation, in other words a white iron. There has been little definite information published except odd analyses, until the last few years when Adamson, Dr. Schüz, Dr. Goerens, Dr. Jungbluth and the present writer* have all published the records of experiments upon the effect of silicon on chill, that is to say the precipitating action of silicon on carbon. There remains much to be done to systematise in tabular form this effect of varying silicon with varying carbon.

The diagram drawn up by Maurer, we are told, has been used for some years in German foundries, and a later and improved diagram by Greiner and Klingenstein has now superseded it. Many no doubt are familiar with these, and make use of them, but these only cover part of the range of alloys, and for real utility foundrymen would all like a complete table of carbon and silicon.

The present position is this, that having decided the composition of the metal for a given casting, the founder by taking a chill test may measure the suitability of the iron, and possibly adjust by adding other iron. Naturally the same chill test may result from a high carbon iron with low silicon or a lower carbon iron with higher silicon.

Higher silicon is required to precipitate graphite in low carbon irons and the effect of mass is more pronounced, that is to say, the more massive the object cast the slower the cooling, and hence longer time for the carbon to be precipitated. The resultant of these two forces is, that if it be required to produce an exact depth of chill, erratic results are liable to follow unless very great care is exercised. It was actually found that with lower carbon irons, it was necessary to wait much longer to obtain a reliable chill test.

Pearlitic Iron.

It will be naturally expected that some reference will be made to pearlitic irons, and much has been published as to the merits of Lanz, Thyssen Emmel and other irons. Then again, it has been stated that British foundrymen have for years been making pearlitic iron, which is no doubt quite true. Herr Emmel says that in some castings, notably piston rings, both ferritic and pearlitic irons give good results, but the graphite formation is the ruling factor, so that is one example where the service demands do not depend on the combined carbon. Put in another way the particular quality sought for generally, depends on the total carbon and how it is arranged in the structure, and Herr Emmel's example turns on the latter point. Figs. 6, 7, 8, show a few pearlitic irons.

The complete information is gradually coming to hand, and before long it is hoped that the exact relations of total carbon contents, silicon contents, casting temperature and mould conditions, together with the size and shape of the casting, will all be systematically correlated.

What does emerge from the discussions is, that if improved cast iron is going to be produced, this will come about by close scientific control of composition, temperature of casting and study of the work required.

* See F.T.J., June, 1925, etc.

The Continental Steel Trust.

The representatives of the Continental Steel Trust met last week in Luxemburg to continue the discussions concerning the proposed formation of sale syndicates, in the first place for semi-finished material and shapes. Difficulties are said to be still in the way of an agreement on the question of the tonnage allotments, the Belgian and French works continuing to demand a 10 per cent. increase over their production in the first quarter of 1926.

The representatives of the Polish works were to meet shortly at Warsaw to reconsider the offers hitherto made to them by the Trust and to discuss the counter-offers to be made by them at their next meeting with the representatives of the Trust. The majority of the Polish works do not seem to be anxious to join in view of the improvement in their own home market.

Personal.

MR. R. H. ARCHER-COULSON has been appointed by Bolckow, Vaughan & Company, Limited, Middlesbrough, as manager of their Cleveland Steel Works at South Bank, in succession to Mr. J. S. Kerr, who has left the company's service to take up a position in the Manchester district.

SIR ARTHUR PEASE, acting on medical advice, has resigned the chairmanship and the position of managing director of Pease & Partners, Limited, but retains a seat on the board. The directors have elected Lord Gainford as chairman, and Mr. Claud E. Pease has been elected managing director.

Wills.

WORSLEY, C. J., of Melson Street, Luton, trading as the General Engineering Works £5,049

RAINE, G., 10, Montagu Avenue, Newcastle, formerly chairman and managing director of Raine & Company, Limited £59,298

WILLIAMSON, R., a director of the Mountstuart Dry Docks and Shearmans, Limited, a director of Mordey, Carney & Co., Limited, Newport, of John Shearman & Company, Limited, Cardiff, Barry and Avonmouth, and John Shearman & Company, Newport £59,296

Newton, Chambers & Company, Limited.—MR. W. NEWTON DREW, presiding at the annual meeting, at Sheffield, remarked that the stock in trade was down by about £60,000 and investments by £116,000. The debts owing to creditors, including tax reserves, etc., were reduced by an amount approximately equal to the preceding two amounts. What had happened was that a large stock of pig-iron, and some investments, had been sold and the proceeds used to reduce tax liability. The figure for property and plant had increased about £30,000, and the debts due and cash on hand were approximately the same in both years. The miners of Newton, Chambers & Company, Limited, than whom no finer body of men existed, suffered bravely during those dreary months for the impossible ends put before them by their leaders, and were now many of them loaded with debts and in danger of working short time. He could not say that trade prospects were good; they hardly appeared so, but their plant was of the best and their methods throughout of the most modern.

Co-operative Industrial Research.

The Department of Scientific and Industrial Research have issued a report dealing with the subject of "Co-operative Industrial Research," being an account of the work of Research Associations under the Government Scheme. In the course of some introductory remarks it is recalled that the war, and all that has happened since the war, has given a tremendous impetus to the idea of co-operation as a powerful means of dealing with many of the difficulties with which we are faced. The co-operative movement in trade had its origin in this country, and had made great progress before the war. Its extension since then to other fields has been rapid, and in none more interesting than its promotion of industrial research both here and in the United States. Although the Government proposals for the encouragement of industrial research by co-operative associations of manufacturers were made as long ago as 1918, there are probably many who would welcome a general explanation of the scheme then put forward and of its outcome. The time is appropriate, for the majority of the Associations established under the scheme have completed the first five years of their existence, and, as each Association has approached the end of that period, its work has been reviewed in some detail with the assistance of independent experts appointed specially for the purpose. The present document is based upon the findings of these reports and upon the knowledge acquired by the Department of Scientific and Industrial Research through the administration of the grants made to the Associations over a period of eight years

Iron-Founding Industry.—In judging the metal industries one must remember that the science of metallurgy is comparatively young, and is undoubtedly capable of great future development. To some extent the iron-founding industry is at a disadvantage among the metallurgical industries owing to the fact that it includes a great number of small units, often mere "jobbing" foundries, scattered throughout the country. Consequently the British Cast Iron Research Association has found that, in parallel with its research, it has to do a great deal of educational work, and that the wider utilisation of existing knowledge and experience is as urgent or even more urgent than research. Working along these lines, the Association has, for example, given many of its individual members advice concerning cupola practice. An improvement leading to the melting of 10 tons of metal per ton of coke consumed in place of 8 tons leads to a saving for a foundry with an output of 100 tons a week of £250 per annum, and several members have made savings of this order.

Improvements in the quality of cast metal, due to better melting practice, like other forms of saving are difficult to express in money. Substantial benefits have, however, been derived by members from the advice given by the Association and from investigations on moulding sands which have led to the more careful purchase, treatment and rehabilitation of the sands after use. Members have also benefited by the work of the Association on cupola mixtures for the production of irons required for special service under conditions involving high temperatures, corrosion, abrasion, etc. A remarkable improvement in the mechanical properties of malleable iron has been obtained by the production of metal of small grain size, and the method has been patented by the Association and the process hitherto adopted has been improved by careful selection of the most suitable raw material and of the best methods of treatment. By the examination of actual castings and the demonstration of defects, the Association has consistently urged the adoption of designs which are desirable from the metallurgical point of view. Unsuitable design is a frequent cause of difficulty and loss in the production of castings both large and small.

Non-Ferrous Metals Industry.—The British Non-Ferrous Metals Research Association represents in reality not one industry but a group of industries, concerned in the production and in the utilisation of a large number of metals. A great field of research consequently lies before it. At its inception the Association undertook a thorough investigation of the atmospheric corrosion and tarnishing of metals, a subject of industrial, architectural and domestic importance. It has made an important contribution to the knowledge of the course of this corrosion and has already indicated promising methods for its limitation and prevention. A research into the individual effects of the impurities found in commercial copper has been in progress for five or six years.

In a joint research upon die-casting in which Research Associations and Government Departments are co-operating, the Non-Ferrous Metals Research Association is responsible for the supervision of the work. In die-casting, non-ferrous alloys are cast in permanent metallic moulds, and the method is suitable for the mass production of small parts used in general engineering. The castings are of a high order of accuracy and require little or no machining to make them suitable for their ultimate purpose. With greater knowledge the process is capable of improvement and of wider application, resulting in corresponding economies in general engineering.

Throughout this research three objectives are being kept in view:—(i) The acquirement of greater knowledge of the strength and other properties of die-castings with a view to securing greater confidence in their use; (ii) the evolution of new and improved alloys for use in die-casting; (iii) the prolongation of the life of the moulds and cores. The whole investigation is by no means completed, but it has already yielded results of industrial value. Thus the results of the work dealing with the resistance of steels and cast-irons to attack by molten metal have been utilised by a manufacturer of aluminium-alloy castings with a consequent saving of £100 a month. Another manufacturer, by adopting the method of chromium-plating the cores recommended as an outcome of the same work, has greatly increased the life of the die-casting cores used in his plant. There is little doubt that considerable savings and improvements are being made throughout the trade as a result of the die-castings research.

In the course of a general investigation of the jointing of metals the Non-Ferrous Metals Research Association studied the soft solders and assisted in drafting the British Engineering Standards Association specifications for these. Another research, into the influence and distribution of gases in copper when cast, has yielded results of industrial value. An investigation has been in progress for some years at the instance of the brass industry to improve the quality of brass sheet by a thorough investigation of the material from the basic ingot casting onwards. As a result of the active co-operation of the industry with the investigators, so much light has been thrown on the cause of imperfections and unsoundness in sheet brass that improvements have already been effected in many of the works, and the research has reached a stage at which it is possible to make proposals for substantial improvements in the general practice.

Refractories Industry.—Refractory materials are of some interest to almost every industry, and are of almost critical importance in the production of metals and alloys of all kinds, of ceramic materials and of glass. There is a growing tendency, to which reference has already been made, to use higher boiler temperatures and steam pressures, and hence to demand refractories of improved heat-resisting qualities. The British Refractories Research Association is devoting much attention to the important problems involved in these developments. A great deal of the work is necessarily of a fundamental nature, and there has hardly been time for it to produce results capable of direct utilisation in industry. But a definite improvement in the manufacture of silica firebrick in one area is to be ascribed to its work, and its study of a process for the purification of clays, the use of which had been strongly advocated, showed that it could not profitably be applied to British clays and saved members who had contemplated adopting it a considerable waste of capital outlay.

The Foundry Accident Problem.*

By W. G. Morgan.

Apart from the human aspect in accidents, which is realised and appreciated by everybody, there is the cost, not only to the victim but also to the employer. Owing to the complexity of the interests affected, the whole value of the losses incurred in accidents is very seldom calculated or even thoroughly considered.

This is one, if not the greatest, factor which has contributed to the inactivity in adopting and maintaining efficient means of accident prevention. In this connection the employee is as much to blame for thoughtlessness and the absolutely unnecessary risks which he so frequently takes.

There is not only the loss of income to the victim and possible incapacity to resume his trade again, with all the hardships which would attend such a condition, but also on the employer's part temporary loss of production, cost of training a new man or men, with probably a higher percentage of scrap and a definitely higher allocation of the indirect charges of supervision and clerical work besides compensation. The calculation of costs, if done completely, provides some very startling figures.

The regular recording in the works of all such costs is not advocated, because this information can be obtained in a much simpler form, so long as the relation between this form and costs is comparable for reasonably accurate estimates. If this is done a better appreciaton of the extent of accidents and their influence on production is possible.

The Factory Acts provide that a register be kept of all accidents, giving particulars of the injury, cause, time and place, but in addition it is suggested that duration of absence, estimated value of loss of production, cost of extra labour required, if any, and cost of any labour and materials which may be necessary in guarding against a recurrence of such accidents be added. These particulars are taken out separately in the ordinary routine, and therefore only require the time of tabulating.

The extent of safety organisation in America is greater than in any other country, or perhaps more publicity is accorded to it, yet it is undoubtedly justified. The methods adopted, however, are more peculiarly applicable to the largely cosmopolitan nature of the artisan personnel of the States than to any other country.

It is notable, however, that in America, as in all other countries, progress in the foundry problem is conspicuous by its rear-guard position. This is difficult to account for, but it is probable that one of the chief reasons is the highly complex and uncertain nature of many foundry operations and the apathetic interest of most of its operatives, if a simple solution is not immediately forthcoming.

Fire-Proof Clothing.

It is just that unsympathetic attitude which frustrates any suggested safety measures, and until this psychological condition is broken down no active safety work can be developed. Probably the greatest number of accidents are due to molten or red-hot iron, though it can also be said that it is in this class that most of the readily preventible minor accidents occur. The very nature and appearance of molten iron commands care in its handling, but, in small foundries, and particularly where hand ladles are in common use, strong language as occasions arise is more usual than a systematic layout to facilitate transport and pouring.

The use of fireproof boots and gaiters is not so common in this country as in the States, where they are in general use, but from experience it is found that they are an invaluable asset.

Metal shields on the shanks of hand ladles should be provided, as they very materially reduce the risks from flying metal. Keeping gangways clear when men must carry molten iron is not so strictly observed as may be imagined. In wintertime, particularly, when illumination is never very good failure to enforce these conditions is nothing short of criminal negligence.

It may seem very elementary to state that water should not be mixed with molten iron, but the thoughtlessness of even some adult foundry workers is amazing. Not long ago a moulder, wishing to dry a stop which he had just dipped in a pot of blacking, ignored the fire provided and attempted to balance it on his two bars over a head of molten iron. The stop slipped, and in a second the tragedy had happened. The steam generated blew a shower of molten metal into the man's face, not only severely burning him, but blinding him in one eye and practically destroying the sight of the other.

Such an accident has a tremendous moral effect on the rest of the men for some time. "Some time," that is the whole trouble; if only the latent presence of accidents was constantly borne in mind the men would at least keep within the "White Line."

Defective Ladle Gearing.

Back lash in tilting gears of large ladles is bound to be experienced sooner or later by all casters, and the so-called skill in continued manipulation of the defective mechanism is ridiculous. The person who is most likely to suffer from splash metal is the caster himself, and it is obvious that injury to him may cause a great danger by leaving a tilted ladle of metal uncontrolled.

In connection with burns, there are certain elementary points in first-aid which, although fairly obvious, should be impressed on all workers. Immediately a burn has been experienced, burnt clothing should be ripped away and the flesh covered with cloth of some kind to exclude air; this will greatly reduce inflammation and pain.

Once a labourer who had one day received a burn rushed to a tank of water and plunged his foot therein. The pain must have been severe, for not until a solicitous pal had raised a smile did the fellow observe that the wrong foot was receiving treatment. It is needless to state that water is only an aggravation to burnt flesh.

Dangerous Light Rays.

The chief danger from molten iron is, of course, burns; but there is another influence which is but little understood, and consequently receives less attention than it deserves, that is, the effect of heat and light rays on the eye. There are two types of rays, amongst others, which emanate from molten iron which are very injurious to the sight. They are known as the ultra-violet and infra-red rays, and their effects are somewhat different.

The process of colour reception in the eye is made by a pigment in one series of cells coating another series of cells upon which any image is received. The nature of this pigment is chemically affected by the ultra-violet rays, the period of recuperation depending on the length of exposure, which should necessarily be brief. The infra-red rays cause a physical action which is permanent. Both of these actions ultimately cause colour blindness. These effects can be prevented by interposing a media of the complementary colour, amber-green or smoke tint, in the form of coloured glasses or goggles. Incidentally, of course, the goggles act as a safeguard against the danger of flying metal—a certain cause of colour blindness.

Obviously there is a real necessity of procuring these tinted goggles, at least for the furnaceman. Diffidence is often expressed by operators to the use of these goggles, but if a suitable choice is offered and insistence made on a trial, the man is seldom long in realising the protection they afford.

Lighting of Foundries.

One of the fundamentals of good founding is to provide the workmen with adequate lighting arrangements. There are foundries being worked where artificial light is required all day. That is wrong, not only from the moulder's point of view but the employer's also, because clean work and the proper rate of production are not obtained

* A Paper read before the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, Mr. D. H. Wood, presiding.

XUM

under such conditions. What is of far more importance, the accident liability is doubled. The amount of extra heat permitted to enter during hot weather can be entirely counteracted by fans and cannot be considered an objection, the main factor being the height of the roof.

In winter the necessity for and the importance of providing good artificial lighting is fairly obvious, but generally speaking it receives far less attention than it deserves. The simple condition, for instance, of maintaining the lamp reflectors clean is conspicuous by its absence in most foundries, and yet the intensity of illumination can be reduced 50 per cent. by this accumulation of dust.

Inadequate ventilation when boxes are knocked out as soon as castings are set further restricts lighting and visibility, and thereby at least impedes the movements of casters. Remember that the eye is the most acute sense in preventing accidents.

Defective Hoisting Tackle.

The number of accidents which can occur from defective hoisting tackle are few, but are usually of a severe nature. The cause is generally either the omission to attend to a defective part as soon as the strain has occurred, or ignorance of the danger of straining chains, ropes, hooks, gears, etc. Ignorance is probably the chief cause, and it is therefore the duty of those in charge to see first that everybody who is allowed to use a crane is properly conversant with the defects which may occur, and that they report immediately, and secondly, to see that defective parts receive prompt attention.

To avoid as far as possible the risks which lads may take, it is thought that no one under the age of eighteen should be permitted to sling and operate a crane except under supervision. The importance of care in slinging should be strongly impressed, for a variety of accidents may occur if this is not done properly, and not only to the slinger for he may be passing the job on.

If a moulding box should slip on being rolled over or hoisted, or a link be twisted in hoisting and slip straight a gain whilst in suspension, a stress is put on the whole chain. This stress may be so severe as to develop cracks or stretch in some of the links and this induces hardness with cracks as a result of further stress.

The danger from the presence of cracks is obvious, it is therefore important that immediately after heavy shock stresses have been experienced the chains should be examined by an expert, links replaced where necessary, and the whole chain annealed to relieve strains and re-tested. It is important however that the proper treatment should be given in an annealing furnace. The temperature should be 800 deg. C, and the period of soaking 6 hours after which slow cooling should be allowed.

Steel ropes which are dry and rusty cause friction which under heavy stress is likely to produce strain and rupture of one or more strands of wire. Immediately ratchets in crane blocks begin to slip under their ordinary heavy loads, they should be examined for overload and wear and corrected straight away owing to the close proximity of the man who is hoisting. When the idle chain rides on the block it should be eased off and not made to slip as is usually the practice. The slip effect on the chain links is injurious.

If hemp ropes are used they should be of sufficient size, and in this connection it is advisable to display in a prominent position on the wall simplified charts showing safe loads. It is a great help to standardise signals to the crane-driver. When overhead crane driving is rapid and extensive it is advisable to instal a warning signal gong which will prevent inadvertent collisions.

Other Types of Accident.

Although by the term accident we usually mean a fracture, strain, abrasion or burn to some part of the body one should not lose sight of what can be designated the slowly progressive type of accident. No man will deliberately expose himself to a polluted atmosphere, but the very materials and process of founding create conditions which only the strongest stamina can withstand. The indirect effect of bad ventilation on accidents is seldom realised fully.

The prevalence of lumbago and rheumatism among foundry workers is only too well known. It should be remembered that these diseases occasion spasmodic attacks which may occur when a man is in a critical position. It is not suggested that it is within our scope to cure or entirely prevent these cases, but it is necessary to emphasise the real necessity for correct means of ventilation. The best obtainable leaves much to be desired, it is therefore obvious that one should at least have the best.

Continuous direct draughts should as far as possible be avoided. Fans and loose plates in the roof are the only correct means of ventilation, but when these are employed they are seldom adequately built. Dense fumes evolved during casting cause irritation and many accidents are caused through unseen obstacles in the man's way. Some artificial core binders are responsible for a great contribution towards the murkiness of a foundry atmosphere, and if efficiency cannot be obtained without this pollution then one is advised to change the core binder.

The charging floor is one of the places upon which adequate ventilation should be maintained. The effect of sulphur fumes is most suffocating, and dense emissions are not infrequent, during the blow, especially if there is any tendency of the charge to scaffold or if the cupola throat is constricted. Permanent ventilation should be provided of sufficient size and situated at least seven feet from the floor to avoid cold draughts round the heads of the men.

In connection with sulphur fumes the possibility of being gassed, especially on the cupola charging floor, is not remote, and as in the case of a large works the ambulance room may be situated at some distance from the foundry, the importance of workmen acquiring at least some of the principles of first aid is obviously desirable.

Where circumstances permit it is undoubtedly best to house the fettling department in a separate building for reasons which are fairly evident. Cuts and abrasions are frequent, due to the necessity of constantly handling articles of a more or less rough nature. The provision of leather gloves minimises this, especially for those engaged in the filling of tumbling barrels and the brushing off of work of a lighter character. The large amount of dust which necessarily accompanies brushing off and blowing out of castings can be prevented to a great extent by the use of dust exhausting tables.

The removal of cores from large work could be carried out with advantage in a section of the shop in which special means of ventilation would be required. Respirators should be provided and their use insisted upon by those engaged in the operations just described, and also those whose duty it is to clean out the dust exhaustion pits under the grinding machines and tumbling barrels.

Grinding Conditions.

In connection with grinding machines there are usually not more than two speeds obtained through cone pulleys, so that danger from excess speed of the grinding wheel can be avoided. In mounting wheels, care should be taken that proper felt washers are inserted between wheel and plate or vibration will cause the nuts to slacken and a bursting wheel is probably the result. Wheel guards must be fitted and adjusted and their use insisted upon. Very rarely should even an experienced man be permitted to operate on an over exposed wheel. New men and boys to this class of work should be correctly instructed and strongly impressed with the possibilities of danger and the vital necessity of taking no risks whilst working on the machine.

As in the foundry, goggles are just as useful as in the fettling shop. The goggles should be of plain thick glass, preferably "Triplex" with gauze side protection and proper ventilation. Thick glass goggles cause a certain amount of refraction, and for those men with partly defective sight it is a consideration and an ultimate economy to have specially ground lenses. It is advisable that the men should contribute a small proportion of the cost, as in this way it has been found that they are more appreciated and corresponding care bestowed upon them.

The question of notices, rule books, lectures, etc., is a very debatable one. It is certain that

they in themselves have very little lasting effect, the information therefore should have a striking appeal and be regarded more in the nature of a command. It is very desirable that all notices should be changed periodically in order to maintain the interest of the men.

In conclusion the Author expresses his appreciation and best thanks to Mr. G. Kelway and Messrs. Alfred Herbert Limited for the opportunity and facilities they have afforded him in the preparation of this paper.

Discussion.

In the course of the discussion MR. F. J. COOK said he had known accidents to occur through the wearing of goggles, the man's vision being obstructed. There were plenty of ventilated goggles, but the tendency was for dust to get in. In the case of a man who perspired freely the wearing of goggles was very uncomfortable. The question of the ventilation of foundries was very important, and it was a problem which had not received so much attention in this country as in America. The average architect, knowing nothing about the work of the foundry, was not qualified to make the most suitable arrangements so far as ventilation was concerned. With regard to ladles he emphasised that the shaft which carried the pinion should be supported at each end. As to slinging, it was not so easy as it appeared. Twists in chain put enormous strain on individual links and were likely to cause trouble.

MR. T. H. TURNER suggested the possibility of using a shield of fairly fine wire gauze instead of the customary goggles. It would be the means of breaking up molten metal into such small particles that it would not cause much damage, and would be otherwise effective except from the point of view of dangerous rays. Gloves were not mentioned by Mr. Morgan, but in America they were in almost universal use. Mr. Turner also referred to the possibility of accidents due to the noise preventing a man hearing a warning shout.

MR. D. H. WOOD, in proposing a vote of thanks to Mr. Morgan, attributed 75 per cent. of accidents to negligence.

MR. E. H. TYSON, in seconding, commended the Safety First propaganda.

The vote of thanks was heartily accorded and Mr. Morgan briefly replied.

Institute of British Foundrymen.

Wales and Monmouth Branch.

The annual meeting for the election of officers and other business was held on April 30 at the Angel Hotel, Cardiff.

Mr. J. P. GALLETLY, the retiring Branch-President, in referring to the work of the past year, said the Branch had carried through a programme that was highly creditable, and it compared very favourably with other scientific societies. There had been lectures of the highest order from the vice-presidents, Mr. Ben Hird and Mr. R. G. Williams, and if we can only develop some more talent of that character the Branch will undoubtedly soon become an important influence in this locality.

After expressing his pleasure at being present and taking part in the work of the Branch, he thanked Mr. McClelland, the hon. secretary, on whom had fallen the lion's share of the work.

The following officers were elected:—

As President: Mr. Ben Hird.

As Vice-Presidents: Mr. R. G. Williams and Mr. W. S. Kinsman.

As Hon. Secretary: Mr. J. J McClelland.

As Councillors: Messrs. W. E Clement, Chas. Richards and Wm. Williams.

Mr. McClelland, in giving his report, also referred to the need of doing everything possible to increase the membership of the Branch, and took the opportunity of reading a letter from a member who had gone to India. The member in question, Mr. C. E. Howe, had asked for proposal forms to be used by persons in India who wanted to join the Institute. Such an action was definitely beneficial, and if local firms would but realise the importance of the work carried out by the Institute, and support its efforts, the facilities now available would be materially increased.

Rubber Equipment in Foundries.

Rubber is more used in foundries than many people imagine. The writer visited a large foundry recently where all the men were working with rubber-tipped rammers. The ramming of sand in moulding flasks is an operation that requires much care, both to obtain a satisfactory mould, and also to prevent injuring the pattern. The rubber tip is, of course, a ferrule that fits on the end of the rammer. The advantages of these rammers are that the mould is usually better rammed, that there is less possibility of scabs on the face of the casting, and, if the pattern is fragile, it is not as likely to be damaged if inadvertently struck by the rammer. The rubber is more resilient than iron or wood, therefore it is less likely to fatigue the moulder. The ideally rammed mould is admittedly one which is not a series of sand thicknesses, but one solid body of sand uniformly rammed throughout, and this is more likely to be realised with the rubber rammer.

The sand blast has become indispensable for foundry work and it is rather peculiar that, for this service, a soft hose lasts longer, as the resilient rubber compound resists the abrasive action of the sand blast. It has been proved by experiment that a three-ply duck holds the pressure satisfactorily when the hose is from 1 to 1½ ins. in diameter, and a two-ply when it is ¾ in. in diameter. An expert, from much experience, has expressed himself of the opinion that wherever sand-blast hose is subjected to a bend, the wear will be most severe at that point, because the tendency of the blast is to go straight. This condition exists generally at the wall connection where the blast enters the hose. At this point the lining is often worn away completely on one side while still intact on the opposite side. The life of the hose may be extended by giving it a quarter turn every few days so that all sides of the lining will wear uniformly.

Sand-blast chambers are usually laid with rubber sheeting reinforced with fabric. While the sand-blast chamber, a few years ago, was only found in steel foundries, this method of dressing castings is gradually being adopted in iron and non-ferrous foundries, and rubber manufacturers should keep a close watch on developments in these directions.

Rubber is used for much other foundry equipment. Compressed air is largely used for the operation of moulding machines, and many feet of air hose are under pressure at one time. The efficiency of the machines depends on the quality of the hose, and electrical engineers are not slow to claim that the danger of hose leakage is a big reason why electric power should be used. High quality hose is essential for foundry use.

Hose is used for vibrators, pneumatic tools, air hoists, sand blasts, sand-blast barrels, for wetting down the sand, for paint-spraying machines, and for acetylene and oxygen. There are also rubber caskets for sand-blast barrels, rubber-cloth-inserted sheets for lining sand-blast chambers, hose for pneumatic sand sifters and hose for revolving steel brushes. One of the big points in favour of compressed air is that a leak in the air line or excessive use at a motor will not endanger the operator. In this respect it differs from steam, which clouds the view; electric current is sometimes responsible for a shock or burn; and water, which floods the premises.

Foundrymen who have had much experience with rubber hose are averse to wire winding as a protection against outside wear. It makes the hose heavy to handle, besides which, when it is once bent, the hose is hard to reshape, and a wire covering is more costly than the thick rubber cover recommended as the best protection for the outside of the hose. A foreign foundry journal recommended some time ago that as a connection with vibrators on moulding machines—the air hose used for which is usually $\frac{5}{16}$ in. or $\frac{3}{8}$ in.—the hose should be of the best quality with a good resilient oilproof tube. It should also have a cover of resilient rubber, and the walls should be heavy and substantial. This hose is not subjected to external abrasion, but the cover and wall must be heavy enough to absorb the continued bending without kinking or cracking.

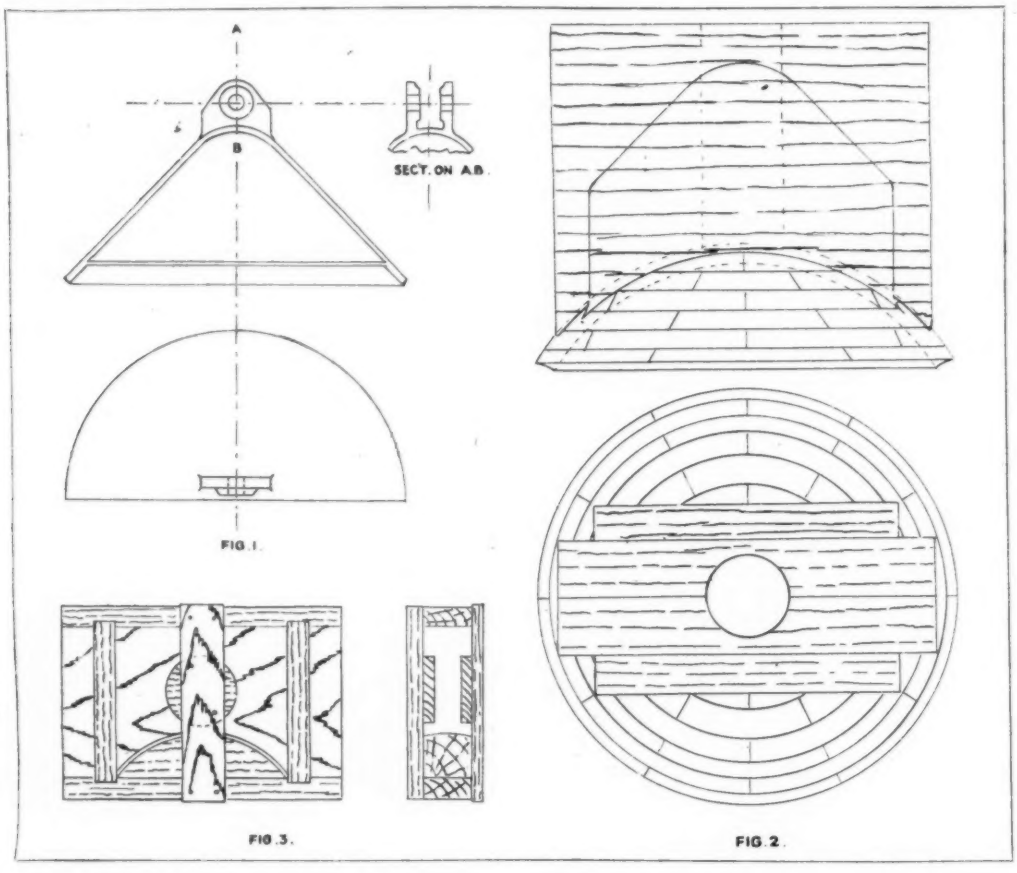
Thicknessing Moulds to Produce Cylinder Castings.

By Ben Shaw and James Edgar.

In this journal it is almost superfluous to say that castings of a cylindrical kind are particularly suitable for sweeping. Either a loam pattern may be swept up, to which subsidiary parts in wood are attached, or a cope may be swept out and subsidiary pattern sections located during the process of building the mould. The method selected depends largely upon the particular shape of the casting required and also the practice usually adopted in any one foundry. Some foundries prefer suitable pattern work made for sweeping the work direct, while others show preference for a loam pattern. In the former method the moulds are usually made entirely with loam and bricks, whereas, when a loam pattern is prepared it is, as a rule, transferred to a pit or case in order that the mould may be made in dry sand.

In many instances the main cylindrical cores are swept up separately and located in their relative positions by prints, while for other moulds the main cores may be made satisfactorily by thicknessing the mould, thus forming a core-box in which the core is built. It is the principle of thicknessing in its application to moulds swept about a vertical spindle that we purpose considering more especially in this article. Sweeping a thickness of sand on a mould consists in making a temporary sand pattern, supported by the mould and enabling the core being made direct on the job. In this instance the method is not one which gives the maximum speed in the production of a suitable mould, but rather the limitation of space necessary for making the mould. This advantage is appreciated when the casting is of large diameter. Not all cylindrical castings are suitable for production in thicknessing moulds, but the method is generally a profitable one when it can be adopted satisfactorily. Considerable economy is of course effected by sweeping moulds. The use of sweeping boards having a profiled edge similar to the general shape of the casting cuts down the cost of patternmaking, as only subsidiary pattern sections are necessary to form any projecting parts not capable of being formed with the profiled edged board.

Fig. 1 illustrates a type of casting for which sweeping boards are particularly suitable to prepare the mould and for which the principle of thicknessing offers the most convenient means of producing the core. The sketch shows two sections and a half plan of a bell casting, such as is used in conjunction with a cone casting for charging a blast furnace. With the exception of the lugs, boards will suffice for giving the requisite shape to the remainder, and as the diameter of these castings is invariably about 16 or 18 feet, their use will be more economical than the preparation of a costly pattern. Reference has been made to the use of loam and bricks in the formation of the mould. The fact that this casting is of steel does not alter the principle, but, in order that the mould will withstand the high temperature associated with molten steel, a more refractory material known as steel moulder's compo is used instead of loam.



To prepare the mould for this casting it is necessary to supply subsidiary pattern work for the lugs, and, as the space between them is comparatively narrow, it is preferable to core out this opening. A core-print should be made similar to that shown in Fig. 2 to which the lugs are attached. This pattern section may be made to carry the lugs and core-print only, the part connecting the spherical end of the casting being shaped to allow the sweeping board to pass over it, or the spherical end may be built up and turned, having the lugs and print attached to it, similar to that indicated in Fig. 2, and, as the mould is to be swept out about a vertical spindle, it is necessary to bore a hole through the centre of the pattern section to suit the diameter of the spindle to be used. Besides the

pattern section, one small core-box and a sweeping board cover all the pattern work that is necessary.

The core-box is very easily constructed, it being simply framed and having a bottom to carry one of the facings, the other being attached to a batten on the top side and accurately located in its relative position by means of dowels, as indicated in Fig. 3. The sweeping board should be made to the inside shape of the casting, the horizontal part of the board being recessed back, as shown in Fig. 4, to form a guide for the cope. To prepare this board for sweeping the mould it is necessary to attach a piece of wood corresponding to the thickness of metal and the profiled edge formed should be reinforced with hoop iron to preserve the shape when sweeping the compo, as represented by the section on A B, Fig. 4.

To prepare a suitable mould for such a casting it is necessary to have a substantial foundation plate, because of the size and weight of the job.

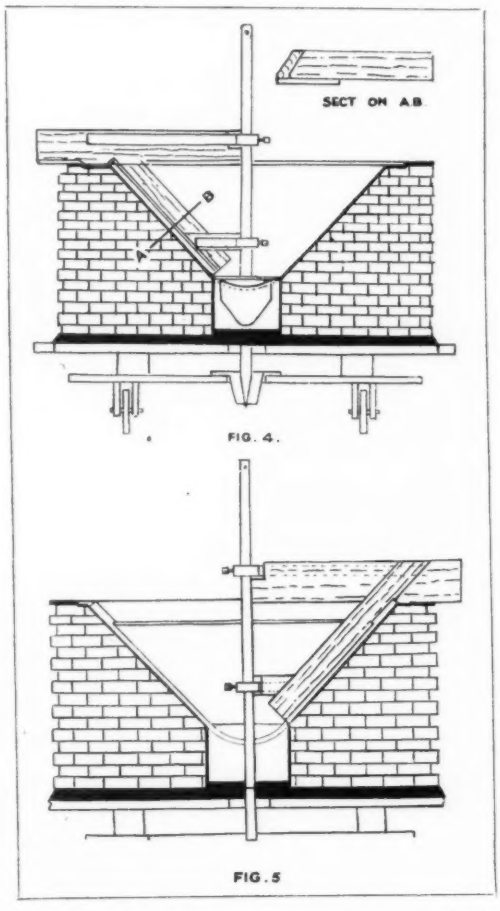


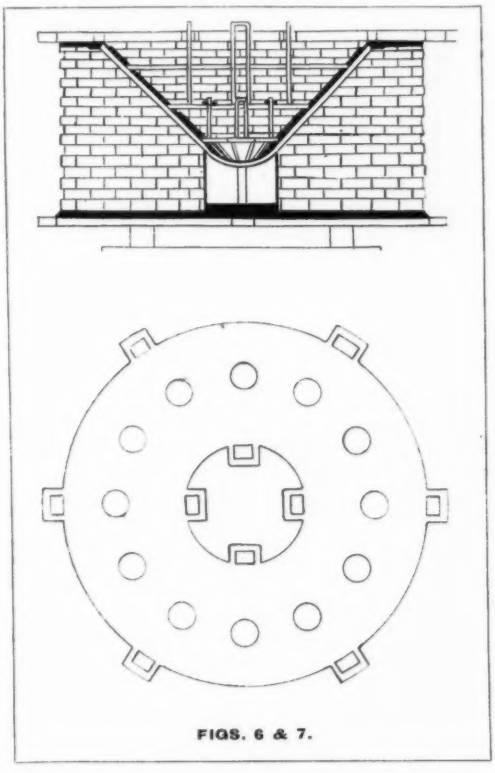
FIG. 4.

FIG. 5

When this has been procured and set on a bogie for convenience in drying, a spindle is located in a socket, as shown in Fig. 4, and the pattern section for the lugs is passed down the spindle and bedded into a special compo facing. The sweeping board is then secured to two spiders or tail pieces, which are fixed to the spindle in such a manner that the position of the board will remain unchanged during the process of sweeping. The operation of building up the mould with compo and bricks can now proceed. It is essential that the face of the mould to be swept should consist of a specially prepared facing of high refractoriness, because of the high temperture of the molten steel. Frequently the brickwork is built up to within an inch or so of the sweeping board and the prepared facing is then applied when the board is rotating to give the requisite shape, as indicated in Fig. 4. When the mould has been prepared in this manner, it should be allowed to stiffen and then the board can be adjusted preparatory to sweeping thickness.

Fig. 5 illustrates the method of applying the thickness, and it will be noticed that a pattern is thus formed, partly in wood but the major part in loam or compo, the mould supporting it while an impression is taken of the top. Either a highly refractory sand mixture or compo may be used to take the top shape. When the former it is advisable to dry the bottom part to withstand the ramming, but if compo is used the work may proceed after the job has been allowed to stand awhile to stiffen. Whichever method is adopted necessitates a considerable lift with the top plate, therefore it is essential that the grids and top plate should be strong.

The method illustrated in Fig. 6 involves the use of bricks and compo. Three grids are used varying in size with the diameter at which they are to be placed. The grid taking the shape of the spherical end has a number of pieces of wrought iron cast in it, about the outside and at an angle corresponding with the shape of the casting required. When wrought iron is used instead of cast iron gaggers they can be adjusted without losing their value. Four staples are cast in this grid also, long enough to penetrate the next grid, to which it is securely wedged, as shown in Fig. 6. The second grid may have cast gaggers about the outside, and four strong staples long enough to pass through the top plate are required to be cast with it. The third plate or grid need not be quite so strong, as it only acts as a ring plate for the brickwork.



FIGS. 6 & 7.

The small grid is bedded into compo applied to the spherical end, facing compo being used against the pattern, and the shape built up with bricks, then a bedding of compo is applied to receive the next grid. When the whole has been built up, as indicated in Fig. 6, and a bedding of compo applied to the joint surface, a top plate, similar to that shown in Fig. 7, may be lowered into position and secured to the staples attached to the second grid. The whole job is required to be dried, when the top part can be lifted, the temporary pattern and wood section removed, when both top and bottom parts can be painted with silica wash. When suitable runners and risers have been made and troughs prepared for feeding the mould, the parts are again transferred to an oven to be thoroughly dried. After having been dried the mould is assembled, a core being set to form the lugs and the top lowered, runners placed, and the top and bottom plates clamped together preparatory to casting. Not infrequently work of this character is lowered into a pit, prepared in the foundry floor, and sand rammed about the outside to assist in withstanding the pressure applied during the time of pouring the metal.

XUM

Trade Talk.

HEDLEY MOORWOOD & COMPANY, LIMITED, have removed to Royal Insurance Buildings, 32, Church Street, Sheffield.

NEWTON, CHAMBERS & COMPANY, LIMITED, of the Thorncliffe Ironworks, near Sheffield, have blown out their No. 1 blast furnace and have started up their rebuilt No. 2 furnace. Their third furnace has recently been dismantled.

JAMES TURNBULL & COMPANY, 3, New Street, Birmingham, have been appointed Midlands representatives for Empson Centrifugals, Limited, 47, Victoria Street, London, S.W.1, for the sale of their machines for the recovery and purification of oils and liquids.

MR. J. S. KERR, who for the last fifteen years has been steelworks manager to Bolckow, Vaughan & Company, Limited, of South Bank, Middlesbrough, has been appointed general manager of the Partington Steel and Iron Company, Limited, of Irlam, near Manchester. His appointment dated from last Monday.

SOME TIME AGO we announced the purchase by Thos. W. Ward, Limited, Sheffield, of the ironworks and foundry of Eastwood, Swingler & Company, Limited, Derby. We are now informed that Messrs. Ward have purchased from the joint receivers and liquidators the remaining portion of the property, formerly used as the engineering, bridge-building and constructional works. The works, which cover 12 acres, have an extensive frontage on the railway immediately south of Derby Station, on the main line from Birmingham.

THE ANNUAL DINNER of the Junior Institution of Engineers was held in London on April 26, when about a hundred members and guests attended. The president (Sir Robert B. Dixon) was in the chair, and the guests included Sir Murdoch Macdonald, M.P. (President-Elect), Sir Henry Fowler, Brig.-General P. R. C. Groves, and Mr. H. T. Tizard. The toasts included those of "The Institution," "The Engineering Industry," "The Guests," and "The Chairman," and in connection therewith several entertaining speeches were made which greatly contributed to the enjoyment of a very pleasant evening.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, of Elswick, have been given an order for 22 capstans for the Calcutta Port Commission. A contract for the manufacture and shipment by the first week in October next of about 4,000 tons of steel work for a new terminus of one of the railways in South America, "Modern Transport" states, has been placed with the Horseley Bridge and Engineering Company, Limited, of Tipton, Staffs. An order for thirty 30-cwt. hydraulic cranes required by the Port of London Authority has been divided between the East Ferry Road Engineering Works Company, Limited, of Millwall, London, E., and the Hydraulic Engineering Company, Limited, Chester.

MR. V. STOBIE, of Dunston, was elected president of the Newcastle and District Branch of the Institute of British Foundrymen at the annual meeting held on April 29. The following elections also took place: Senior vice-president, Mr. Colin Gresty; junior vice-president, Mr. R. H. Smith; hon. treasurer, Mr. H. F. Parsons; hon. secretary, Mr. F. Sanderson; members of Branch Council, Mr. F. Allan, Major K. C. Appleyard, Mr. S. Dickinson, Mr. G. Lillie, and Mr. W. J. Molineaux; delegates to the General Council, Mr. C. Gresty and Mr. J. N. Simm. The report showed that the membership showed a slight decrease—from 232 to 209. The diploma of the Institute had been awarded to Major K. C. Appleyard. After the business meeting a discussion on foundry problems was opened by Mr. W. J. Paulin.

THE CLYDE shipbuilding production in April was fair, the 33,768 tons represented by the 21 vessels launched showing an advance of nearly 3,000 tons compared with last month. For the four months to date, the output consists of 46 vessels, aggregating 77,870 tons. In April of last year 13 vessels of 35,900 tons were launched, and for the four months ending then the returns were 54 vessels of 120,362 tons. The same month of 1925 saw the launching of 24 vessels measuring 94,046 tons, and the total for the first four months of 1925 was 76 vessels of 237,504 tons. During the month it was announced that Alexander Stephen & Sons, Linthouse, are to build a turbo-electric liner of 19,000 tons gross for the Peninsular and Oriental Steam Navigation Company; Charles Connell & Company, Scotstoun, a cargo steamer of over 5,000 tons for T. & P. Harrison, Liverpool; and the Ayrshire Dockyard Company, Irvine, a cargo steamer of 1,000 tons for the Newcastle and Hunter River Steamship Company, Sydney, N.S.W. An order for a coasting vessel has been placed with Clyde builders, while several important contracts are impending.

Contracts Open.

Ashborne, Derbyshire, May 16.—300 tons of cast-iron regular pipes and specials of 7-in. and 3-in. dia., for the Urban District Council. Mr. R. Williams, clerk, Ashborne. (Fee, £2, returnable.)

Horsforth, May 27.—(a) Sewage ironwork, and (b) six 53 ft. circular revolving sprinklers, for the Council. Mr. J. E. Aldersley, engineer and surveyor, Council Offices, Horsforth. (Fee, £2, returnable.)

Horsforth, May 27.—Six tons of 6-in. cast-iron pipes and 11 tons of 12-in. cast-iron pipes, together with specials, for the Urban District Council. Mr. J. E. Aldersley, engineer and surveyor, Council Offices, Horsforth.

Leeds, May 21.—Cast-iron pipes, wrought tubes and fittings, iron castings, merchant iron and mild steel, bolts and nuts, washers, gas and pipe hooks, tinplates, black and galvanised iron, sheet lead, lead tube, red and white lead, etc., for twelve months, for the Gas Committee of Leeds. The Town Clerk, 26, Great George Street, Leeds.

Newport, Mon., May 21.—650 yards of 9-in. cast iron and steel water mains, for the St. Mellons Rural District Council. Messrs. Thomas and Morgan & Partners, engineers, Pontypridd. (Fee, £3 3s., returnable.)

Plymouth, May 19.—Gas valves and three under-pressure tees and valves, for the Borough Council of Plymouth. The Town Clerk, Municipal Buildings, Plymouth.

Pretoria, S.A., June 16.—20,000 ft. 6¼-in. screwed and socketed piping, approximately 9,000 ft. swelled and cressed casing, approximately 7,000 ft. flush-jointed piping, approximately 2,500 ft. seamless tubing, for the Department of Irrigation. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference A. 4600.)

Richmond, Surrey, May 23.—Electrically-driven centrifugal pump, with motor, etc., complete, for the Corporation. Mr. H. P. Williamson, engineer and manager, Riverside, Richmond.

Wallasey, May 14.—Castings, phosphor-bronze, iron and gunmetal for six or 12 months as from July 1, for the Ferries Department. Mr. G. Livsey, town clerk, Town Hall, Wallasey.

Weltevreden, Batavia, June 7.—Cast-iron socket pipes, sluice valves, fire cocks, boring rods, pig lead, etc., for the Waterworks Department of the Batavin Municipality. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference A.X. 4606.)

Company Reports.

Glenfield & Kennedy, Limited. — Dividend, 6 per cent. actual, making 10 per cent. for year.

United Flexible Metallic Tubing Company, Limited.—Net profits for 1926, £15,070; dividend, 6 per cent., less tax, for year; reserve, £2,000; carried forward, £8,385.

Robert Stephenson & Company, Limited.—Brought forward, £15,312; Government taxation not required, £11,211; loss for year, £481; available, £26,042; dividend, 4 per cent. for year, less tax, £8,800; carry forward, £17,242.

Pease & Partners, Limited.—Loss for year, £252,806; interest on debenture stock and sinking fund, £66,000; depreciation of plant, £38,388; debit at profit and loss account as at March 31, 1926, £252,472; total amount standing to debit of profit and loss account, £609,667.

Anderson-Grice Company, Limited.—Gross profit, £3,163; brought forward, £167; interest on loans, etc., £124; rent and debt recovered, £7; depreciation on buildings, machinery and plant, etc., £1,324; Imperial taxation, £181; ordinary dividend, 3d. per share (10 per cent.); carried forward, £452.

William Dixon, Limited.—Net profit, £71,385; brought forward, £8,523; total, £79,908; interim dividend on 5 per cent. cumulative preference shares, £7,500; dividend on 5 per cent. cumulative preference shares for half-year ending February 28, £7,500; dividend, 7½ per cent. (free of tax) on ordinary shares, £49,200; carried forward, £15,708.

New Companies.

Adams and Carter, Limited.—Capital £3,000 in £1 shares (1,000 6 per cent. non-cumulative preference and 2,000 ordinary). Iron and steel merchants, etc., heretofore carried on at 18, Vicarage Road, Blackheath, Birmingham, as Adams and Carter.

Aluminium Supply, Limited, 1, Colonnade Passage, Birmingham.—Capital £500 in £1 shares. Dealers in aluminium, etc.

TEAM BY-PRODUCT COKE CO., LTD.

DUNSTON-on-TYNE

"TEAM" PATENT COKE

SPECIAL FOUNDRY QUALITY

FOR PRICE AND PARTICULARS APPLY TO:—

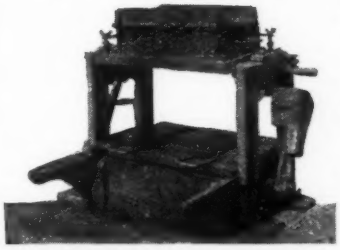
ALEXANDER LEITH & CO.,
25, COLLINGWOOD STREET,
NEWCASTLE-ON-TYNE.

TYPICAL ANALYSIS *(if necessary guaranteed)*

ASH	not exceeding	8%
SULPHUR	„ „	0.8%
VOLATILE	„ „	1 %
MOISTURE	under	1.50%

HAND-RAM TURN-OVER

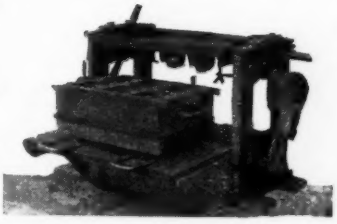
MOULDING MACHINE



SIMPLE, SUBSTANTIAL, ACCURATE.

MODEST IN PRICE.

STANDARD SIZE
Takes Boxes up to 24″×18″×8″



Patentees and Makers:

JOHN BOOTH & SONS, *General Ironfounders,* RIPPONDEN, nr. HALIFAX.

PIG IRON

and

High Grade

CYLINDER IRON

For Motor Castings.

FOUNDRY & FURNACE COKE

J. C. ABBOTT & Co LTD

LLOYD'S BANK CHAMBERS, NEW STREET, BIRMINGHAM.
TELEPHONE: MIDLAND 170.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The announcement at last week's markets of a reduction of 5s. per ton in the price of Cleveland No. 3 G.M.B., though not altogether unexpected, was none the less welcome, as an indication that the era of inflated pig-iron values is at last on the wane, and that a further stage towards the re-establishment of competitive values is now within measurable distance of actual realisation. The market, however, continues at somewhat of a disadvantage in the matter of extended buying, consumers contending that prices are still at too high levels for large-scale forward business, and, though the outlook is no doubt a little brighter, much will depend upon the course of fuel prices. Quotations now stand as follow:—No. 1, 77s. 6d.; No. 3 G.M.B., 75s.; No. 4 foundry, 74s.; No. 4 forge, 73s. 6d. per ton.

On Tees-side, hematite, being an open market, subject to no artificial restrictions, prices have found a level which has already had the effect of stimulating business. East Coast mixed numbers are down to 82s. per ton, which, having regard to the high price of coke, is considered to be a practicable figure. On the North-West Coast prices are unchanged, with Bessemer mixed numbers quoted at £4 14s. 6d. per ton delivered at Glasgow, £4 15s. 6d. per ton delivered at Sheffield, and £4 18s. per ton delivered at Birmingham.

LANCASHIRE.—Consumers of foundry iron in this locality are but slightly affected by the drop in Cleveland prices, and purchasers are still on a restricted scale awaiting further developments. For delivery into the Manchester area, Derbyshire No. 3 iron is now quoted at round 88s. per ton, with Staffordshire at 88s. to 89s., Scottish brands at from 102s. upwards, and East and West Coast hematites at from 93s. to 94s.

THE MIDLANDS.—At Birmingham market this week prices of foundry pig were practically unaltered, current quotations ruling as follow:—Derbyshire and Staffordshire, 80s. f.o.t. furnaces; and Northants at 77s. 6d. to 78s. 6d. per ton; Scotch No. 3, 105s.; and Lincoln, 91s. per ton, all delivered the Midlands.

SCOTLAND.—In Scotch iron there is very little business being done, and prices are being continually cut. The makers' quotation to-day for No. 3 foundry is 84s. f.o.t. furnaces.

Finished Iron.

The demand for all classes of finished material, with few exceptions, continues unsatisfa tory, and most works are hard pressed to keep plants running. Fortunately, the demand for marked bars keeps fairly good, but the call for crown and cheaper qualities of iron is very meagre indeed. The price for marked bars is £14 10s. at makers' works, and crown iron fetches £11 per ton and up. The price for Continental No. 3 iron remains weak, and offers have been made at £5 16s. 3d. to £5 17s. 6d. delivered this area. It is quite hopeless for the English works to endeavour to compete here, and the local works' nut and bolt iron remains in the neighbourhood of £10. It will be seen from this that most of the nut and bolt works' business for the Darlaston works will be placed abroad. One of the North Staffs Ironworks has closed down for an indefinite period.

Steel.

The market for semi-products is only moderately active, and the anticipated revival of business has so far failed to materialise. True there is a fair lot of buying of acid billets, but basic qualities are on the feeble side. Acids continue at £11 per ton delivered, and the quotations for basic are: Soft, £7 10s.; semi-hard, £8 2s. 6d.; medium, £8 12s. 6d.; hard, £9 2s. 6d., all delivered in this district. Sheffield industry is, generally speaking, in a fairly satisfactory position, but here and there are bad patches. Crucible steelmakers report a falling off of orders, and there is a slowing down of activity in open-hearth steel production. The heavy pipe foundries are full of work, but the mills rolling wire rods have been put on short time.

Scrap.

Markets for scrap metal in general reflect little change, the only exception, perhaps, being that in Scotland, where cast-iron borings are in a little better demand around 47s. 6d. to 48s. per ton. Turnings are still 50s. per ton. Heavy machinery cast-iron scrap in pieces not exceeding 1 cwt. is easy at 78s. 6d. per ton, and for ordinary cast-iron scrap to the same specification 74s. to 75s. per ton. Light cast-iron scrap is still around 57s. 6d. to 58s. per ton, and this material is changing hands freely at these prices. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—Movements in base metal values in the past week have been somewhat irregular, with standard copper tending to weaken levels, due in the main to slower American and Continental consumptive demands. From the home consumers' point of view, the chief causes of complaint have been that from time to time the c.i.f. Europe quotation has been maintained at a higher level than was considered warranted by the selling price to domestic users in the United States.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £54 15s. to £54 16s. 3d.; Friday, £54 18s. 9d. to £55; Monday, £55 6s. 3d. to £55 7s. 6d.; Tuesday, £55 11s. 3d. to £55 12s. 6d.; Wednesday, £55 5s. to £55 6s. 3d.

Three Months: Thursday, £55 5s. to £55 6s. 3d.; Friday, £55 8s. 9d. to £55 10s.; Monday, £55 16s. 3d. to £55 17s. 6d.; Tuesday, £56 2s. 6d. to £56 3s. 9d.; Wednesday, £55 16s. 3d. to £55 17s. 6d.

Tin.—Fluctuations in standard tin of late may be explained by a substantial amount of bear covering, speculative buying, and replacement orders by those who had sold to America, while France also came into the market. It is not, however, thought that the price will soar again; at least, not for long. It is suggested that the excellent April statistics may be followed by a succession of visible supply increases, which would keep undue optimism in check.

Official closing prices of standard tin have been as under:—

Cash: Thursday, £299 17s. 6d. to £300 2s. 6d.; Friday, £297 5s. to £297 10s.; Monday, £299 to £299 5s.; Tuesday, £297 10s. to £298; Wednesday, £297 5s. to £297 10s.

Three Months: Thursday, £290 10s. to £290 12s. 6d.; Friday, £288 to £288 5s.; Monday, £289 10s. to £289 15s.; Tuesday, £288 2s. 6d. to £288 5s.; Wednesday, £288 to £288 5s.

Spelter.—The market for this metal has been dull, with a slow trade demand, the slump in lead having obviously discouraged new support. The position on the Continent, however, seems to be improving a little, stocks there having been reduced to some extent during the last month; albeit, a full output is going on.

The following are the week's prices:—

Ordinary: Thursday, £29 8s. 9d.; Friday, £29 10s.; Monday, £29 11s. 3d.; Tuesday, £29 11s. 3d.; Wednesday, £29 6s. 3d.

Lead.—Values of soft foreign pig have been maintained at fairly steady levels, with, however, a weaker tendency. In regard to the price reductions across the Atlantic, rumours have been in circulation to the effect that this development has been the outcome of a policy adopted in order to influence European and Australian smelting interests towards a proposed curtailment of operations.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £25 17s. 6d.; Friday, £25 13s. 9d.; Monday, £25 12s. 6d.; Tuesday, £25 10s.; Wednesday, £25 7s. 6d.

New Type of Welding Electrode.—A new type of welding electrode, which combines the characteristics of a fluxed electrode and the quality of bead finish and the cleanness in handling of a bare welding electrode, has been introduced by the General Electric Company, Bridgeport, Conn., U.S.A. Recommended for the general welding of steel, the electrode has, it is claimed, a uniform flowing quality. The absence of spattering is one of the advantages claimed for the new material. The elimination of the erratic arc condition leads to a deposit of more material with the same consumption of electrode per kw.-hr. The electrode penetrates quickly and produces high tensile strength and unusual ductility and elongation.